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Fig. 2 (A) Lipoma viewed through cyst of kidney. (B) Cut surface of lipoma on kidney, showing mottled surface and encapsulation.

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## MASSIVE LIPOMA OF THE KIDNEY

WITH REPORT OF A CASE

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**L**IPOMATA of the kidney are of quite rare occurrence. They are usually very small, not larger than a cherry, and may be mistaken for metastatic growths, benign adenomata, or even hypernephromata, as the last of these are often very rich in fat.

When lipomata of the kidney are present in persons who have died from septicæmia, they may be mistaken for metastatic abscesses. In a rather thorough survey of the literature we have been able to find only 5 proven cases in which lipomata have attained an unusual size. We add the following case report to this very small group.

### CASE REPORT

On December 21, 1925, a white woman, 52 years of age, came to the Cleveland Clinic complaining of pain, contraction of the rectum, indigestion, and nervousness. The familial and past histories were unimportant. She stated that this illness began in February, 1925, with trouble in evacuating the bowels and resultant small stools. Increasing difficulty and pain caused her to consent to an operation in the hope that the rectal condition might be corrected. (This was probably a dilatation under a general anæsthetic.) Shortly before her visit to the Clinic she began to have almost constant indigestion and pain in the epigastrium, associated with gas and with nervousness which began to increase very much shortly before she came for examination. During the preceding month she had lost 12 pounds in weight. She complained of a great deal of headache in the parietal region, of being dyspnoic, very weak, and constipated. Because of the pain in the stomach

she slept very poorly. The menopause had just been passed. The only urinary symptom was occasional nocturnal micturition.

Examination disclosed a well developed but rather emaciated elderly woman who appeared to be very much worried and ill. There was a fine involuntary tremor of the head (Parkinsonian syndrome) and an external strabismus of the left eye which she stated had been present for a month. Except for tenderness and a palpable mass in the left kidney region, the physical examination disclosed no abnormality.

Although it was assumed that the mass was connected with the kidney in view of the symptoms of indigestion and constipation, an X-ray examination of the gastro-intestinal tract was made. The findings in this examination were normal. The blood sugar, blood counts, hæmoglobin and the urinary findings were also normal. The cystoscopic examination of the bladder disclosed no abnormality. A pyelogram of the left renal pelvis, however, showed a deformity (Fig. 1, A and B) which strongly suggested the presence of a new growth.

In view of the pyelographic finding an operation was recommended. At operation the kidney was found to contain a large, subcapsular yellow tumor which was very friable and looked not unlike a hypernephroma (Fig. 1, C).

This growth, which seemed to involve the entire mid portion of the kidney, extended down into the hilus and over toward the spine retroperitoneally. Everyone present at the operation believed that the condition was malignant, and we were therefore surprised by the following pathological report.

**Pathological report.** The gross specimen is an enlarged left kidney weighing 420 grams. In the middle on the lateral surface there is a large globular, subcapsular tumor mass which when viewed through the capsule had a yellowish appearance (Fig. 2, A). On section, it is seen to be about 4 inches in diameter



Fig. 1A

Fig. 1. Appearance of lipoma of kidney on pyelogram. It was necessary to take the pyelogram while the gastro-intestinal tract contained barium. B Diagrammatic representation of lipoma of kidney. Outline of specimen superimposed upon that of pyelogram. C Kidney containing lipoma after nephrectomy. Pelvis filled with a 15 per cent solution of sodium iodide and vesicles injected with bismuth subnitrate.

and fairly well encapsulated, the cut surface presenting a fatty yellowish mottled appearance. The renal vessels do not appear to be involved. The renal pelvis is very much narrowed by the compression of the tumor mass upon it. The tumor is very friable (Fig. 1B).

Microscopic sections taken through the growth show similar pictures characterized by a typical lipomatous structure which consists of a reticular fibrous connective tissue surrounding vacuolated spaces from which the fatty substances have been dissolved. In a few areas around the fairly numerous large blood vessels there are aggregations of some what proliferative fibroblastic elements (Fig. 3).

The pathological diagnosis was renal lipoma (fibrolipoma).

The patient made an uneventful postoperative recovery. In view of the fact that the growths are thought to recur locally, he was later given a short course of deep X-ray therapy. On July 23, 1936 the daughter of the patient reported that her mother

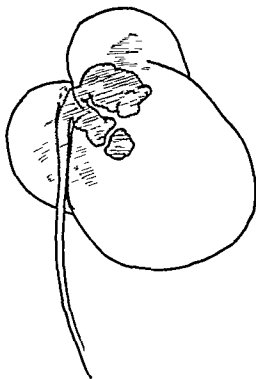


Fig. 1B

was up and about, was eating well and was doing some housework. The pain and constipation had disappeared and there was no frequency of urination. There were no signs of local recurrence. The Parkinsonian syndrome was unchanged.

#### GENERAL DISCUSSION

True lipomata of the kidney must not be confused with the lipomatous deposits around the pelvis which occur in atrophic diseases of the kidney first described by Virchow or with the enormous perirenal tumors first presented by Salzer (10). Tumors of the latter type often so envelop the kidney that it may at first be assumed that the growth is primarily renal. Such cases have been reported fairly frequently (Holmes 6, V. Cantoni 4, Samuels 11). Furthermore it should be remembered that a lipomatous deposit in the kidney may be part of a general tendency of the body similar to fibromatosis.

#### PATHOLOGY

Iwing (5) states that lipomata of the kidney originate in two sites: (1) the undersur-

face of the renal capsule, and (b) the hilum. The pelvic lipoma, therefore, may be an extension from the cortical growth. This was the condition in our case in which there was a marked increase of the peripelvic and retroperitoneal fat which was granular in appearance and looked not unlike a rapidly growing very cellular "fatty" hypernephroma. As Keenan and Archibald (7) have stated the finding of a collection of fat in an organ in which fat normally is not seen should surely awaken one's curiosity. These authors who have presented a most thorough pathological review of the subject, have proven that these lipomata fall into this class.

On the basis of the gross pathological appearances, Keenan and Archibald make the following classification of fatty growths in the kidney:

"(1) The typical hypernephroma, looking like a lipoma, (2) the true lipoma, (3) the combination of these two in one nodule, lipohypernephroma, if we may call them so, each element remaining separate, (4) the lipomyoma, or lipo myo sarcoma, of Mueller, and (5) the degeneration lipoma of Ulrich."

Various articles on these subjects concerning the controversy between Grawitz (quoted by Warthin, 13), Virchow (quoted by Warthin, 13), Selter (12), and Beneke (3), have led us to the following conclusions:

1 The occurrence of lipomata in the kidney is rare.

2 Before the diagnosis of lipoma is made, one should make sure by microscopical examination that the suspected growths are not adenomata or adrenal rests.

3 Although lipomata of the kidney are usually small—rarely larger than a cherry—5 cases in which they have attained considerable size have been reported (Warthin, 13, Grawitz, Bartsch, 2, Alsberg, 1, and Keenan and Archibald, 7).

4 Degeneration of lipomata or the replacement of normal tissue by lipomatosis secondary to calculus, tuberculosis, inflammatory atrophy, or operative trauma (Masson and Horgan, 9) are not rare. These arise from the fat around the pelvis.

Paul Manasse (8) discussed true lipomata of the kidney but mentioned only those of



Fig. 1C

smaller size. He thought they were due to a displacement of the fatty tissue of the capsule to the kidney parenchyma and not to a changing of the kidney connective tissue into fat.

Beneke (3) thought that lipomata might be due either to displacement of fatty tissue or to a metaplasia of the original kidney connective tissue, as the lipoma arborescens arises from tendinous articular ligaments. He gives this conclusion after an examination of 3 cases, but since no definite description of the growths in his series is given, particularly as to their size, and since no case reports were included, we could not include Beneke's cases in this collection of massive lipomata.

# SYMPTOMS

The principal symptoms of lipomata of the kidney, which are usually mild, are pain or discomfort in the region of the involved organ, these symptoms varying with the size of the growth. Hæmaturia is seldom encountered, constipation and gastric symptoms may be present. In our case the symptoms were at first thought to be due to a disorder of the gastro intestinal tract.

# DIAGNOSIS

Lipoma of the kidney occurs in middle age, and all the reported cases have been in women.

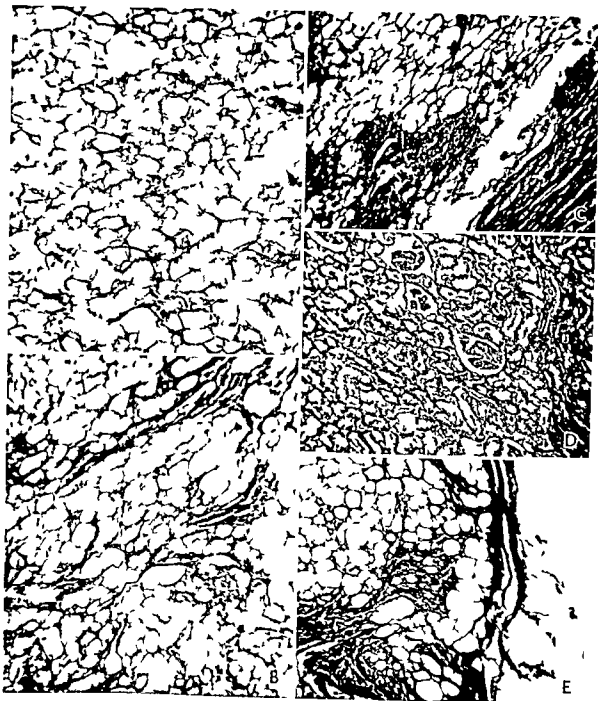


Figure 3 Photomicrographs of lipoma of kidney (X110) *A* Section from center of growth. Note scarcity of fibrous tissue. *B* Section from peripheral portion of growth. Fibrous tissue more pronounced. *C* Section from margin of growth. No true capsule the tumor being sur-

rounded by compressed renal tubules. *D* Section from portion of kidney not involved by growth (one pole). Note diffuse degeneration. *E* Section from area where growth is in apposition to true renal capsule suggesting possibility that growth arose from the capsule.

TABLE I—PATHOLOGICAL CHART OF REPORTED CASES OF MASSIVE LIPOMA OF THE KIDNEY

Author	Treatment	Size	Type of tissue	Number	Position	Capsule
Warthin	Nephrectomy	Large (14 by 8 by 6 inches)	Fibrolipoma No adrenal tissue Numerous blood vessels No hemorrhage or pigment deposit	Single	Between cortex and medulla	None
Crawitz		Large (23 by 19 by 12 centimeters)	Angiomylipoma Areas of angiomatous (arterial) nature some of smooth muscle mostly lipomatous	Single	From hilus to cortex Poles left free	Fibrous Compression of kidney tissue around it
Birtsch		Large With kidney measured 25 by 19 by 12 centimeters	Myolipoma Smooth muscle tissue and lipomatous tissue	Single	Not definitely stated	Not definitely stated
Alsberg	Nephrectomy	Size of a mullet seed to that of a walnut	Fibrolipomata Somelipomatous Some fibrous Some mixed (lipomatous) adrenal rest found	Multiple	Scattered evenly throughout cortex and medulla	
Keenan and Archibald	Nephrectomy	Large (one) Small (one)	Adenolipoma Mainly fat Scattered thick walled blood vessels surrounded by young fibrous tissue Parenchymal cells containing fat cells	Multiple	Under capsule in middle of kidney It divided kidney both ways	Well marked off but no definite capsule
Lower and Belcher	Nephrectomy	Large (14 by 11 by 8 centimeters)	Fibrolipoma	Single	Under capsule in middle of kidney It divided kidney both ways	Well marked off but no definite capsule

TABLE II—CLINICAL CHART OF REPORTED CASES OF MASSIVE LIPOMA OF THE KIDNEY TREATED SURGICALLY

Author	Age	Side	Sex	Symptoms	Associated diagnosis	Postoperative course
Alsberg	40	Right	F	Symptoms of inflammation of abdomen for 10 years Pale Much loss in weight	Questionable	Well 2 years after operation
Warthin	31	Left	F	Difficulty in childbirth Tumor mass abortions	No statement	Cured?
Keenan and Archibald	Adult age?	Right	F	Attacks of dull pain in right side Lump in right side	None	Well 2 years after operation
Lower and Belcher	52	Left	F	Indigestion Pain in epigastrium Constipation	Parkinsonian syndrome	Well 8 months after operation

The growth can be diagnosed only by examination of the tissue but in our case the tumor was thought to be malignant even after the kidney had been removed, and its true character was established only by the pathological report. The diagnosis of tumor in our case was established by the pyelogram.

#### TREATMENT

The only treatment is the removal of the tumor by nephrectomy, which should be followed by X-ray therapy.

#### PROGNOSIS

These tumors are very prone to recur. At each recurrence the tumor is more cellular in type than its predecessor and ultimately the tumor assumes sarcomatous characteristics.

#### SUMMARY AND CONCLUSIONS

1 A sixth case of massive lipoma (fibrolipoma) of the kidney has been presented, the fourth one to be removed by nephrectomy.

2 The characteristic features of this case are apparently identical with those of the one reported by Warthin.

3 In this case the principal symptoms were apparently referable to the gastrointestinal tract. In general the symptoms in these cases are mild and similar to those presented by any tumor of the kidney.

4 This case, like all other reported cases, was in a woman of middle age.

5 The pyelogram showed definitely a deformity of the kidney pelvis.

6 Lipoma of the kidney is probably less malignant than has generally been supposed.

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## SUTURE OF THE FACIAL NERVE WITHIN THE TEMPORAL BONE

WITH A REPORT OF THE FIRST SUCCESSFUL CASE

BY STIRLING BUNNELL M D SAN FRANCISCO

**A**LTHOUGH the facial nerve has frequently been severed in the course of operations for mastoiditis, its repair by direct suture in the region of the middle ear has not yet been reported. Because of the technical difficulty of suturing such a tiny nerve so deep in the bone, other methods have been adopted such as anastomosis with the eleventh and twelfth nerves or facial plastics. These methods robbed the tongue or shoulder of some function and though they restored some voluntary expression they failed to restore emotional expression.

## HISTORY

In 1898 Faure at the suggestion of Furet first joined the proximal end of the eleventh nerve to the distal end of the seventh nerve. The operation was repeated by Kennedy in 1899 and Cushing in 1902.

In 1900 Mannasse first did it on dogs and obtained faradic response, and Kennedy in 1911 using the eleventh and twelfth nerves in dogs and monkeys, noted some degree of motor return and decrease in asymmetry.

Korte, in 1901, was the first to anastomose the twelfth and the seventh, he reported the results in 1903. In that year Ballance reported anastomosis of the eleventh and seventh, which gave associated movements only.

In 1910 Grant reported joining the eleventh nerve to the seventh and stated that he prevented atrophy of the trapezius or weakness of the shoulder by joining the descendens hypoglossi to the distal end of the eleventh nerve.

In 1913 Ballance repeated this joining the twelfth to the seventh nerve and joining the descendens hypoglossi to the distal end of the hypoglossal nerve to prevent atrophy of the tongue.

Eden in 1911 advised transplanting a strip of masseter muscle to the angle of the mouth

and one of the temporal muscle to the angle of the eye.

Since then many operators have used the eleventh or twelfth nerves to anastomose to the distal end of the facial and it has become customary to join the proximal end of the descendens hypoglossi to the distal end of the eleventh or twelfth to preserve the tone of the trapezius or tongue respectively.

## RESULTS AFTER SPINOFACIAL AND HYPOGLOSSOFACIAL ANASTOMOSES

The symptoms of facial paralysis have been aptly described as follows: "The eye cannot close and constantly weeps. The mouth dribbles, the speech is interfered with, and mastication is impaired. The delicate shades of continence are lost. Joy, happiness, sorrow, shock, surprise, all the emotions have for their common expression the same blank stare."

Anastomoses of the eleventh or twelfth nerves into the facial nerve will restore tone and voluntary movement to the paralyzed side of the face and also symmetry if the face is kept at rest, but not when under emotion. They are attended, however, by atrophy, loss of function and associated movements and do not restore emotional facial expression.

Severance of the spinal accessory nerve is followed by atrophy of the trapezius muscle, a high position of the scapula and some impairment of free and forceful movements in elevating the arm and shoulder. Loss of the hypoglossal nerve causes atrophy of half the tongue and a varying amount of interference with articulation, mastication, and swallowing.

Associated movements always result from these anastomoses and persist permanently unless reeducation is successful. Stookey reports a case 10 years after a spino-facial union in which associated movements and no others existed. The patient could not close





Fig. 1. Showing how the facial nerve as represented by a wire pursues a course around a right angle as it emerges from the stylomastoid foramen and how 8 millimeter in length can be gained by extending it to the vertical position. The nerve can run in the hypobulbar line of the right angled triangle and thus run in a straight line from the parotid gland to the middle ear. The nerve was sutured in the middle ear where the tip of the wire was.

his eye without raising his shoulder or turning his head. In many cases reported facial grimaces occur when the shoulder is moved and in glossopharyngeal cases the facial contortions accompanying mastication lead to embarrassing situations. Some of the patients who had skill and perseverance have re-educated themselves so that these associated movements were repressed and they could make voluntary movements of that side of the face and imitate to some degree facial expression. This however is voluntary and not emotional facial expression. (C. C. Coleman states) The response of the muscles to emotional stimulus gives prominence to the deformity so that rigid repression of all facial movement is likely to become a fixed habit. Adson writes: From this review of the literature it is evident that the spinofacial or the faciohypoglossal anastomoses do not offer all that is hoped for in the restoration of facial control. It is true that regeneration takes place that facial tone returns and that voluntary movements can again be performed but it is also true

that the patient has difficulty in expressing emotion on the side that was paralyzed and that dissociated movements of the face occur when the shoulder or tongue is moved.

It might be thought that re-education is more apt to follow when the twelfth nerve is used rather than the eleventh as the cortical and medullary centers and the peripheral distribution are closer to those of the seventh but clinically this has not been marked. Re-education has been as great after spinofacial anastomoses. Not as yet has emotional expression come as cortical centers have not been known to change in this. Twelfth nerve fibers will continue to function as twelfth nerve fibers even though growing down the seventh nerve. Theoretically emotional expression may develop after anastomosis has been done in infants by changing the function of the brain centers but our cases are usually adults.

Direct suture of the facial nerve brings emotional facial expression naturally and has not the disadvantages of atrophy and loss of function and associated movements. Although the operation is technically difficult there is in the attempt nothing to lose and all to gain.

#### INDICATIONS FOR OPERATION

Of the various facial plexuses there is much in the selection of a suitable case. Fortunately it is usually possible to diagnose the site at which the facial nerve is interrupted. As the nerve has not as yet been successfully sutured as far proximal as the geniculate ganglion we can exclude cases showing symptoms arising from lesions proximal to this point.

Lesions within the skull are suggested when the upper facial is spared and there is involvement of the sixth nerve, the pyramids or pons or the association of lesions of the sixth to the twelfth cranial nerves of that side.

Suppression of lachrymal secretion and herpes of the cornea suggest involvement of the geniculate while diminution of saliva without loss of taste, trismus, nerve deafness and changes in equilibrium a lesion proximal to it.

Suitable cases should be free from these symptoms and should show in addition to







Fig 4



Fig 5



Fig 6



Fig 7

Fig 4 Photograph taken 17 months after suture of right facial nerve. Tone has returned to the facial muscles, restoring the symmetry of the face at rest.

Fig 5 Photograph taken 17 months after suture in the middle ear of the right facial nerve to show the degree of voluntary motion of the right side of the face.

Fig 6 Photograph taken 17 months after suture of the facial nerve to show both sides of the face in symmetrical voluntary contraction.

Fig 7 Photograph taken 17 months after suture of the right facial nerve, showing that emotional facial expression is restored.

If the vaginal process of bone had not been chiseled away, the nerve ends could not have been approximated. The facial nerve turns a right angle as it enters the stylomastoid foramen, so that by chiseling away the vaginal process the nerve can be transplanted as the hypotenuse of the triangle in a straight line from the parotid gland to the middle ear. Thus gained for us 8 millimeters, so that the nerve ends could easily be approximated without tension. Opening and shutting the jaw did not increase the tension on the nerve, but drawing the jaw forward pulled the nerve 2 millimeters. The posterior wall of the facial canal was chiseled away as deeply as to the level of the nerve to facilitate the needle work. Adrenalin and wax were of service in obtaining a dry field.

The suturing of these tiny nerve ends in such a deep and awkward place was difficult. From the level of the surface of the skull the nerve ends were  $\frac{7}{8}$  inch deep and the soft parts still further deepened the pit. The nerve ends were sutured together by 4 sutures of finest silk placed through their sheaths by tiny curved eye needles. The usual straight needle could not be used. In repairing over 100 nerves in the hand and fingers some practice in suturing very small

nerves had already been gained and this made the present suturing possible. I would strongly advise, however, that an operator first perfect himself in suturing small nerves (obtainable at a meat market) before attempting the present operation.

A pedicle strip  $2\frac{1}{4}$  inches long of the surface of the sternomastoid muscle was turned up and used to cover the nerve suture and to fill the concavity, and the wound was closed.



Fig 8 Photograph taken 14 months after suturing of the right facial nerve showing that emotional facial expression is restored.

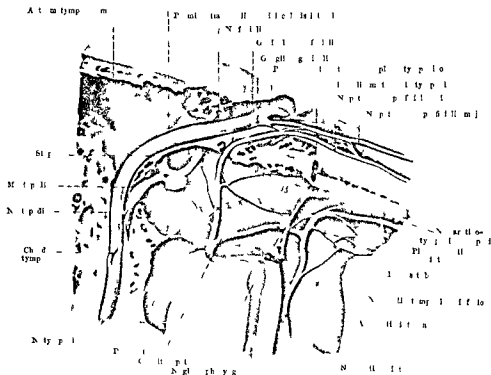


Fig. 3. Right facial nerve and its relation to the facial canal. The nerve was sutured just posterior to the stylus. (After Spaltholz.)

incision was prolonged down a crease in the neck for 2 inches. The ear and soft parts of the meatus were drawn forward and the remains of the meatal wall exposed. The mastoid region was chiseled which enlarged and widened the excavation until the middle ear and lateral sinus were in view. The latter had been exposed at the former operation and adherent to the lateral sinus and directed backward was found the neuroma of the proximal end of the facial nerve. It terminated 6 millimeters down from the bend of the facial canal. The severance therefore was just posterior to the pyramidal eminence on a level with the center of the posterior wall of the middle ear. As the facial canal was laid open to as far forward as the genu care was taken not to injure the lateral semicircular canal which prominence is just posterior and superior to the nerve. From the geniculate ganglion at the genu the facial canal which has walls of firm bone passes backward, downward and outward forming the

prominence of the facial canal bends around the vestibular fenestra and pyramidal eminence and passes vertically downward through the thick bone of the mastoid process to the stylomastoid foramen. The front edge of the mastoid process and the vaginal process which runs from the mastoid to the styloid process were chiseled away until the full length of the vertical portion of the facial canal was laid open. The distal end of the facial nerve was found to be slightly attenuated and densely adherent in the facial canal 5 millimeters below the point where the proximal neuroma ended. With a probe the nerve branches were freed somewhat as they entered the parotid gland. Thus gained a few millimeters in length. The branches to the stylohyoid and posterior belly of the digastric muscles were still holding the nerve, so these were sacrificed. Four millimeters of the neuroma were removed and some from the distal end of the nerve until good nerve bundles were reached in each nerve end.



Fig 4

Fig 5

Fig 6

Fig 7

Fig 4 Photograph taken 17 months after suture of right facial nerve. Tone has returned to the facial muscles restoring the symmetry of the face at rest.

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## COMMENT

If it be found impossible to approximate the nerve ends a short free graft from the sural nerve of the leg can be used with good chances for success if the approximation is very accurate. If one does not succeed in suturing or grafting no harm is done by the operation and resort may be had to one of the anastomosing methods.

Since performing the above operation in reviewing the literature I found that Dr K. W. Ney described in 1922 an operation similar to the above as a possibility but had never performed it.

## REGENERATION OF THE NERVE

*Six months after operation* The patient noticed the first signs of improvement. Previous to this time the right eye burned and his wife stated that it remained open in sleep. From now on the eye remained closed in sleep and the burning stopped. Up to this time the right side of the lips felt stiff and he could not say such labio dentals as "55". The stiffness left and he could pronounce "55". He ceased using adhesive plaster on the face to keep the paralyzed muscles in relaxation. When shaving until the present time he noticed a tickling in the right cheek which ran to the helix of the ear. This has now left. Touch still causes a tickling about the right side of the lips and chin. His face never had loss of sensation but the right side had felt stiff and tingled when touched.

*Eight months after operation* The upper facial is not yet active. He has now seven wrinkles that come voluntarily under the right eye and three at the side of the mouth. He can now voluntarily produce the nasolabial fold and also one further posteriorly and below it. Food still catches in the right buccal pouch but less so than before.

*Nine months after operation* Speech still improving. He easily pronounces "55". Food has ceased catching in the buccal pouch.

*Eleven months after operation* Up to this time tears ran down the cheek from the right eye every few minutes, now they scarcely do so. Speech has improved considerably more.

*Thirteen months after operation* He first whistled both by the lip and the tongue methods.

*Fourteen months after operation* The tickle elicited by touching the right side of the face is now almost gone. When a spot an inch in front of the ear is touched he feels it in the helix (crossed axones). There is now good voluntary action of all of the muscles of the face including the platysma but with the exception of the frontalis. He can produce deep nasolabial folds on the right side, purse his lips, puff out the cheeks and blow without puffing out the right cheek. The right eye can voluntarily close tightly making many wrinkles. It remains closed in sleep and tears do not run over. The speech is now without defect. Taste is still absent in the anterior two thirds of the tongue on the right side but is not expected to return as the chorda tympani was not repaired. Emotional expression has returned to the face and in the correct distribution.

*Seventeen months after operation* The face when at rest is symmetrical. The facial muscles work more easily and quickly and independently in each part of the face. The face feels natural and has no more wooden or tense feeling. He chews on both sides of the mouth and food never catches in the buccal pouch. He holds a cigarette well on the right side. There is no abnormality in swallowing or in the tear or salivary functions and no difficulty in speech. The frontalis muscle which is the last to recover now shows slight voluntary motion and has normal and quick electrical reactions. Emotional expressions play over the face freely in a natural manner and with correct distribution in the various parts of the face.

ACUTE INFECTIONS OF THE LOWER ABDOMEN<sup>1</sup>

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THE difficulties of diagnosis in appendicitis I believe, are due largely to a failure of many to appreciate the fundamental facts of the pathology of acute appendicular disease. Until we realize that there are two separate and essentially different acute diseases of the appendix—the one acute inflammation of its wall, the other acute obstruction of its lumen, each with its own pathology and its peculiar clinical picture, we shall continue in greater or less confusion in interpreting the clinical manifestations in different cases.

## ACUTE APPENDICITIS

An acute infection of the wall of the appendix is of common occurrence and gives rise to symptoms constitutional in type, such as might be anticipated in a lesion primarily infective—thus malaise, loss of appetite, rise of temperature and pulse rate, coated tongue, epigastric discomfort, often amounting to pain, sometimes vomiting, and later some rigidity and tenderness in the right iliac fossa. The milder degrees of such disease must often come and go without the physician being called on either for diagnosis or treatment. The scarred, stenosed, and fibrosed appendices so often found are witness to such past and possibly forgotten attacks. Progressive inflammation may result however, and when an early diagnosis is made, prompt operative interference is the wisest course.

## ACUTE APPENDICULAR OBSTRUCTION

For this disease a preceding attack of inflammation is usually responsible. A stenosis near the proximal end of the appendix has compromised the free ingress and egress of fecal matter. A portion of retained fecal content hardens to form a concretion, and then at some time, usually without warning, the peristaltic action of the appendix drives the concretion into the narrow stenosed area

and there impacts it. The appendix is now completely obstructed, with what result? This question can be answered most simply by reference to animal experiment. If one ligates the appendix of a rabbit at its proximal end, leaving the meso-appendix with blood supply intact, one finds that the sequel depends entirely on the content of the appendix at the time of obstruction. If the appendix was empty, a mucocele slowly develops, with no apparent disturbance of the animal's health (Fig 1). If a small amount of fecal matter was contained within the appendix the latter becomes distended with pus and an empyema of the appendix results (Fig 2). If a considerable amount of fecal matter is pressed from the cecum into the appendix before the ligature is applied, the animal is always dead within 24 hours from a gangrenous perforated appendix (Fig 3). An isolated loop of ileum in the cat behaves similarly under the same conditions (3).

Exactly the same sequel of pathological changes occurs in the human subject when the appendix becomes obstructed, the degree of pathology depending on the amount of fecal content at the moment of obstruction (Fig 4).

*Clinical picture in acute appendicular obstruction.* The patient is suddenly seized with acute cramp like pain in the epigastric region, just above the umbilicus, and vomits. The pain gradually subsides but returns in spasms, usually with repeated vomiting. Frequently the attack starts during the night, and for the first 6 to 8 hours there may be *no rise of pulse or temperature*, even though the appendix may by this time be well on the way to gangrene. The patient usually looks ill and realizes that something is seriously amiss in his abdomen. There is almost always some tenderness and rigidity in the right lower quadrant.

Such a case should be treated with the *promptitude and immediacy of an intestinal*

<sup>1</sup>Read before the Clinical Congress of the American College of Surgeons Montreal October 1926



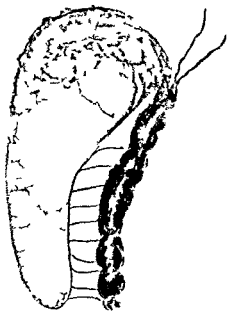


Fig 1

Fig 1 Experimental appendicular obstruction in the rabbit. Mucocele of appendix. Animal in good health killed 21 days after ligation of proximal end of empty appendix.

Fig 2 Experimental appendicular obstruction in the rabbit. Empyema of appendix 10 days after ligation of



Fig 2



Fig 3

proximal end of appendix containing small quantity of fecal matter.

Fig 3 Experimental appendicular obstruction in the rabbit. Gangrene and perforation of appendix with death 24 hours after ligation of proximal end of appendix containing much fecal matter.

obstruction which it really is, otherwise perforation into the free peritoneal cavity will result in the evacuation of the pent up decomposing fecal matter with disastrous consequences. Immediate operation with a free abdominal incision so that the distended appendix may be freely exposed to view delivered and removed without rupture is the only rational treatment. If the appendix is removed without perforation even though it be gangrenous no peritoneal drainage is necessary.

*Expectant treatment in acute infections.* There can now be no doubt that when acute disease of the appendix is diagnosed in its early stages immediate operation should be carried out. This is the only safe rule for general application. When a case of appendicitis is not seen or is not recognized until the fourth day however the question of operation is a much more difficult one to decide. If there be general distention or if a firm in-

flammatory mass be felt and there is no definite evidence of a considerable collection of pus if the patient's general condition is fairly good and the pulse below 110 it is wiser to treat on expectant lines with morphia, hot fomentations and proctoclysis. If a localized abscess develops this may be evacuated. The great majority of these patients who have successfully weathered the peritoneal storm for 4 days will recover. A meddling operation will precipitate a goodly number of them into a critical condition which may terminate with death. A good rule is to ask oneself in the early cases whether there is any good reason why one should not pursue the safe course and operate and in the late cases in reasonably good condition whether one is justified in interrupting the natural process of cure which is by that time well established. To operate on all cases at once no matter at what stage they are recognized is to allow reason to be overruled by prejudice.

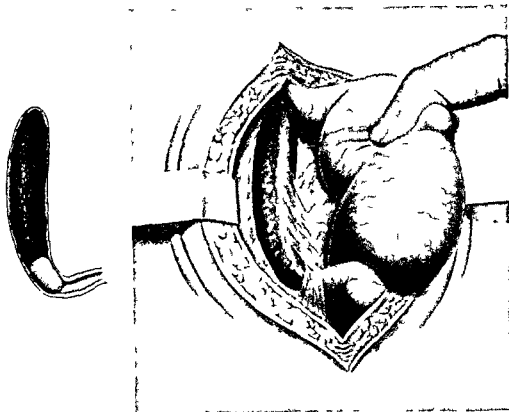


Fig 4 Acute appendicular obstruction Retrocecal appendix exposed 16 hours after onset of symptoms Inset shows appendix opened constriction impacted at angle Decomposing fluid fecal matter filled distended and gangrenous distal portion

Two other groups of cases are, I believe, best treated on expectant lines, namely, the peritonitis associated with acute gonococcal salpingitis and that associated with acute diverticulitis of the pelvic colon, the latter usually in stout individuals Unless a definite abscess be present, no help is given by operation in such cases

#### DRAINAGE IN LOWER ABDOMINAL INFECTIONS

There has been at all times a tendency to standardize our treatment of abdominal infections Thus a period of peritoneal lavage was succeeded by an era of dry surgery, the fashion of free and multiple drainage was followed by a swing back to no drainage at all I would appeal for standardization in our treatment of such infections Prejudice in favor of one particular line of treatment in all cases can only reduce the chances of recovery in some cases While the remarkable recuperative power of the undamaged peritoneum may be trusted to deal with all moderate infections, provided no gross foreign mat-

ter is left within it, it is equally true that where ragged and especially oozing surfaces are laid bare a drain to the damaged area is logical and helpful surgery

#### ABDOMINAL WALL INFECTION

In many cases in which a gangrenous or a perforated appendix has been removed a drain inserted, and the abdominal wall stitched up, the first few days after operation are marked by considerable constitutional disturbance which clears up about the fourth day, when some foetid discharge escapes alongside the drain This discharge comes not from the peritoneal cavity but from the abdominal wall This sequence of events is most marked in stout subjects

The abdominal wall is much less capable of dealing with infection than is the peritoneum, and it is peculiarly susceptible to the attack of anaerobic organisms, especially when non-vital tissue in the form of buried sutures is present A much smoother postoperative course is ensured in such cases by bringing the peritoneum and muscular tissues lightly

together by silk worm gut sutures the ends of which are brought out at the same side of the wound and tied over a piece of rubber tubing or through a button and the wound in the skin and subcutaneous fat left wide open and packed with gauze. If a Carrel tube is inserted under the gauze peroxide of hydrogen may be injected from time to time and the eventual removal of the gauze at the end of 4 days rendered easy and painless. The wound is then strapped and healing in the end is more rapid and complete than in the wound primarily closed where suppuration with sloughing of aponeurosis is so apt to occur.

#### CÆCOSTOMY IN ACUTE INFECTIONS

It is common knowledge that the development of a faecal fistula in a bad peritonitis case following appendicectomy is frequently followed by an immediate improvement in the general condition of the patient. Of late years I have been impressed by the comfort and benefit given by performing a valvular tube cæcostomy in late cases of appendicitis in which a distended cæcum is a feature. Such a valvular opening does not delay convalescence and saves much suffering and distention during the early postoperative period.

#### JEJUNOSTOMY IN THE OBSTRUCTION OF PERITONITIS

A postmortem study of cases dying of so called peritonitis 5 to 10 days after operation

for acute appendicitis convinced me that intestinal obstruction accounted for death in quite 75 per cent of cases. That quite recent lymph adhesions may cause a fatal small intestinal obstruction was readily demonstrated by experiment (4).

Victor Bonney (1) emphasized the value of jejunostomy in these cases and Sampson Handley (2), in his paper on ileus duplex, re-affirmed and extended those observations. The presence of colicky pain with distention some days after the primary operation is the indication for jejunostomy which must be done sufficiently high to drain the upper jejunal loops where the toxic content lies. If performed by a valvular method and through the omentum as recommended by C. H. Mayo, it need leave no fistula and is a truly life saving operation.

In conclusion I would appeal for an open mind in dealing with lower abdominal infections a problem with such diverse manifestations and complications that no standardized methods can meet all contingencies. Let us regard each case as a problem in itself to be dealt with under the dictates of sound surgical principles.

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EXCISION OF ULCER OF THE DUODENUM<sup>1</sup>

BY E. STARR JUDD, M.D., F.A.C.S. AND GUNTHER W. NAGEL, M.D. ROCHESTER, MINNESOTA

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THE operation for excising ulcers of the duodenum has not gained in popularity to any great extent for two reasons first, the results of gastro enterostomy when performed for this condition have usually been satisfactory, and second unless the first portion of the duodenum is free and mobile excision of an ulcer is technically very difficult. Unless it is possible to excise the ulcer with just as little risk and as good a prospect of satisfactory results as attends gastro enterostomy then there is no occasion for excision. The ideal operation for any condition is one that removes the lesion causing the trouble with the minimum of disturbance and leaves the least possible chance of recurrence.

If it were not for the occurrence of second try ulcers in the jejunum in some cases after gastro enterostomy the results of this operation in cases of duodenal ulcer would be almost perfect. Jejunal ulcer does not occur as often following gastrojejunostomy as some are trying to make us believe but it does form at times. It is impossible at present to estimate how frequently it occurs or to specify the type of case in which it is liable to develop. The most interesting phase of the problem is that certain persons seem to have a predisposition toward ulcer and that in such persons ulcer will form repeatedly in spite of the eradication of all foci of infection and notwithstanding the most rigid management and dietary precautions from the time of the operation.

It was a case of this kind that aroused our interest in the possibility of elaborating some procedure by which the ulcer could be removed and gastrojejunostomy avoided. The patient was a young man who for many years had had symptoms suggesting duodenal ulcer. He had had several courses of treatment by the late Dr. Sippy and on each occasion had been completely relieved of all of his symptoms during the time that he was under treatment. They recurred however as soon as he

varied the routine. The nature of his business made it very difficult for him to follow the plan laid down for him. He prepared for operation with the hope of being completely and permanently relieved of all of his symptoms. At operation gastro enterostomy was performed for a small ulcer found on the anterior surface of the duodenum. Shortly afterward symptoms recommenced in spite of the rigid dietary regimen that he had maintained. Four weeks later an ulcer at the stoma was observed under the roentgen ray. At the second operation the ulcer was excised and the stoma enlarged. The patient was advised to continue the rigid management that had originally kept him free from symptoms. After 3 months the resumption of a regular diet precipitated an immediate return of the symptoms. The roentgen-ray showed deformity of the stoma characteristic of jejunal ulcer. The patient returned willing to try further operative work. At the third operation the gastro enteric anastomosis was taken down and a small ulcer of the duodenum excised. Complete relief of symptoms followed. This indicated to us that simple excision of the small ulcer in the first place would have saved him the other two operations. This happened about 14 years ago and since then we have excised all ulcers of the duodenum when it seemed possible to do so.

The method of operating which we now use has been evolved from earlier methods. In the earlier cases we simply excised the ulcer and closed the opening in the duodenum so as not to interfere with the intestinal lumen. In no instance did we attempt a plastic operation on the pylorus. In some of these cases the symptoms were not completely relieved but the ulcer did not recur. We then extended the operation by dividing the pyloric sphincter after excising the ulcer. The ultimate results in these cases were the same as in those in which nothing had been done to the pylorus but because of the larger opening on the

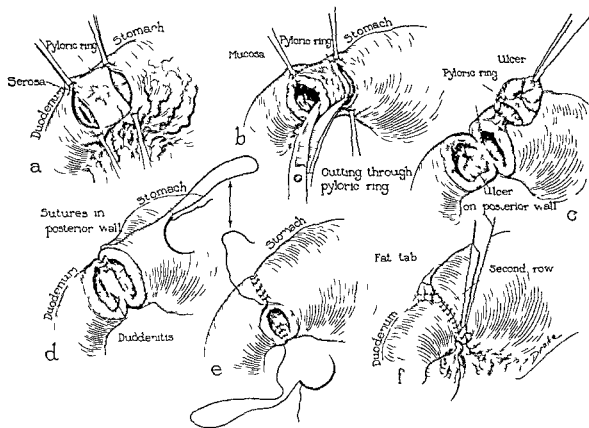


Fig. 1. Fixation of duodenal ulcer, partial resection of pyloric sphincter and gastroduodenostomy.

stomach side the operation was technically easier to perform. Certain of the symptoms in cases of ulcer are the result of tension and spasm due to the action of the sphincter. It would seem advisable in all operations for ulcer to perform some operation that would permanently do away with the activity of the sphincter. Plastic procedures such as dividing and suturing in opposite directions do not seem to abolish the sphincter action for any length of time. Following most plastic operations which include division of the sphincter there is still a sphincter action. It may be slight at first but after complete healing it is usually just as active as before the plastic operation. We believe that this condition is the cause of the high percentage of unsatisfactory results following plastic operations on the pylorus.

Apparently the only method of destroying sphincter activity at the pylorus is to remove

all or part of the muscle. Removal of all of the muscle necessitates complete pylorotomy. This seems a more formidable operation than is warranted in cases of simple duodenal ulcer and moreover it may be followed by scar and contracture interfering with the lumen. A much more conservative and simple operation is the excision of the anterior half of the pyloric sphincter together with the cap of the duodenum and the ulcer (Fig. 1). In most cases the ulcer occurs in the cap of the duodenum and enough of the duodenum may be removed to justify classifying the operation as partial duodenectomy. When this portion of the duodenum has been removed and the anterior part of the sphincter excised the two openings, one at the lower end of the stomach and the other at the upper end of the duodenum, stand out just as the two openings of a gastroenterostomy after the posterior row of sutures has been put in. The technical steps

of the operation are not difficult so long as the tissues are well exposed, and exposure is readily carried out if the operation is not attempted in cases in which the ulcer is some distance from the pylorus or in which the duodenum is too firmly fixed to be readily mobilized

#### MULTIPLE ULCERS

It is likely that single ulcers do occur but it is probable that in most instances more than one ulcer is present in the duodenum. Many times we have been able to demonstrate several ulcers in a small piece of tissue excised. However, we have often found areas of duodenitis without being able to demonstrate any true ulceration. Since we have been excising the affected portion of duodenum in cases of this kind, we have had a better opportunity to study the surgical pathology of the duodenum and have been especially impressed by the number of cases in which more than one ulcer is found, by the frequency with which duodenitis is encountered and by the constant association of ulcer and an area of duodenitis on the posterior surface in the mucous membrane, about 1 centimeter below the pylorus. Often an ulcer occurs in this situation, but many times there is no demonstrable ulcer but a congested, easily bleeding mucous membrane. More than 95 per cent of all ulcers of the duodenum occur within two-thirds of an inch of the pylorus. If an ulcer is found on the posterior surface in addition to that in the anterior portion, it should be excised through the opening made by the removal of the cap (Fig 2). It is often difficult to excise the posterior ulcer completely but it can be readily destroyed by the cautery or clipped out in pieces and this surface sutured over. We have often treated posterior ulcers in this manner and with very good results. If the posterior lesion is duodenitis, it is not necessary to do anything to it.

#### SPECIAL INDICATIONS FOR EXCISION AND PARTIAL DUODENECTOMY

We have not felt justified in performing the operation in all cases of duodenal ulcer so far, but have confined it to those in which hemorrhage is a predominant symptom. Gastroenterostomy is often followed by recurrence of

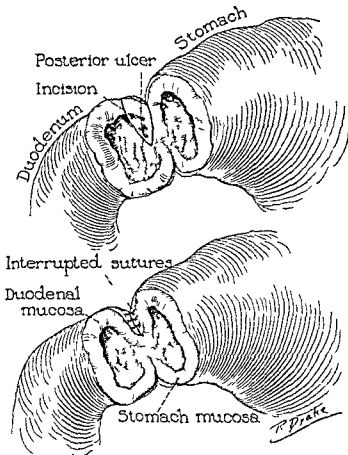


Fig 2 Excision of posterior ulcer

the bleeding. We prefer excision and partial duodenectomy when the patient is young, especially if the history is short. Many such patients can be cured by medical management but failure to respond demands operation. We believe this operation offers all that gastrojejunostomy does and the removal of the ulcer as well. Small ulcers may be overlooked and rarely new ulcers may form after the operation, but the ulcer will not recur as frequently as the jejunal ulcer occurs after gastroenterostomy. The recurrence of an ulcer in the duodenum is not as serious a matter as a jejunal ulcer. Partial duodenectomy should be chosen in all cases in which it can be carried out with no greater risk than attends gastroenterostomy.

#### LIMITATIONS OF THE OPERATION

So far we have not tried excision and partial duodenectomy when the duodenum is firmly fixed, but we are extending its application each year. The duodenum can be mobilized to an extent not realized until we actually try

it. We have not felt that this operation was indicated in cases in which because of long standing inflammation the entire upper portion of the duodenum was converted into a hard cord. In these cases there is great dilatation of the stomach and marked thickening of its wall and no good tissue in the duodenum with which to perform the technical steps of the operation.

Fixation of the duodenum and deformity resulting from long standing trouble necessitate gastro-enterostomy in about half of the cases of duodenal ulcer although the application of partial duodenectomy is being gradually extended. Apparently the tissues of this portion of the duodenum and the lower end of the stomach are not disturbed by the operation for there has not been a single technical failure in any of the cases in spite of the fact that in some cases sutures were placed with difficulty and under considerable tension. Healing has ensued without leakage in all cases.

#### RESULTS OF OPERATION

In attempting to estimate the results of this operation one must consider the question as to what will prevent the formation of other ulcers after the original ulcer has been excised. Until we know more about the etiology of these conditions this question will have to be answered by actual experience with cases. As the report of cases shows there have been a few instances in which new ulcers formed or small ulcers were overlooked at the time of operation. If the ulcer is the result of an infectious process at a remote point then prevention of recurrence of ulceration will depend on attention to all of these foci of infection. By isolating strains of organisms from tonsils and teeth in cases of duodenal ulcer and infecting the blood stream of animals with these organisms a lesion of the duodenitis type can be produced in a rather high proportion of the animals. Organisms can be found in the tissues of experimentally produced ulcers. It seems that there has been considerable evidence presented recently which would tend to support the infection theory of the formation of ulcer. If on the other hand the ulcer is the result of some

physiological disturbance then some changes must be made which will affect physiological processes. The last series of cases in which a considerable part of the sphincter was actually removed have shown sufficient improvement in results to justify this procedure. A careful follow up of all the cases indicates that recurrence of ulcer following this operation is rare.

At first we were very cautious in the application of the operation but the results were so uniformly good in the earlier cases that we have been led to perform it by preference in cases of duodenal ulcer. We have further demonstrated that it is possible to carry out the technique satisfactorily in many cases in which a few years ago we believed it was impossible.

TABLE I—CASES OF THE FIRST AND SECOND GROUPS (188)

	Num- ber
Men	109
Women	19
Oldest	66
Youngest	17
Average age	38
Average duration of symptoms	9
CASES OF FIRST GROUP SPHINCTER NOT DISTURBED (140)	
History previous to operation	
Typical of duodenal ulcer	95
Typical and other symptoms	27
Typical and hemorrhage	10
Not typical	18
Operations previously performed	
Appendectomy	16
Gastro-enterostomy	3
Gastro-enterostomy and appendectomy	8
Cholecystectomy gastro-enterostomy and appendectomy	1
Excision of gastric ulcer and gastro-enteros- tomy	1
Appendectomy and pelvic operation	3
Miscellaneous operations	7
Examinations	
Roentgen ray	
Duodenal ulcer	97
Deformed cap	1
Gastric and duodenal ulcer	1
Gastrojejunal ulcer	1
Indeterminate	5
Obstruction (included in ulcers)	4
Gastric analysis (Groups 1 and 2)	
Combined acids (average)	55
Free acids (average)	40
Operation	
Excision of ulcer	25
Excision of ulcer and appendectomy	96
Excision of ulcer appendectomy and chole- cystectomy	6

	Per cent	Number		Per cent	Number
Excision of ulcer and cholecystectomy		2	physician diagnosed cancer of the stomach		
Excision of ulcer and choledochotomy		1	No details are available		
Excision of ulcer appendectomy cholecystectomy and choledochotomy		1	CASES OF SECOND GROUP, SPHINCTER CUT BUT NOT EXCISED (48)		
Excision of ulcer and cholecystectomy		2	History previous to operation		
Excision of ulcer and gastro enterostomy taken down		2	Typical of duodenal ulcer		40
Excision of ulcer and gastro enterostomy		1	Typical with other symptoms		7
Excision of ulcer, appendectomy and gastro enterostomy		1	Typical and hemorrhage		3
Excision of ulcer appendectomy and excision of jejunal ulcer		1	Not typical		1
Excision of ulcer excision of jejunal ulcer and gastro-enterostomy		1	Operations previously performed		
Excision of ulcer, appendectomy and cholecystectomy		1	Appendectomy		11
(Contact ulcer was cauterized in 15 of the above cases)			Gastro enterostomy		1
Lesion			Gastro enterostomy and appendectomy		1
Duodenal ulcer	130		Appendectomy and pelvic operation		1
Duodenitis	10		Perforating ulcer drained		1
Cholelithiasis	5		Other operations		1
Gastrojejunal ulcer	2		Examinations		
Postoperative sequelae			Roentgen ray		
Bronchitis	1		Duodenal ulcer		38
Bronchopneumonia	3		Gastric and duodenal ulcer		-
Infected wound	2		Gastrojejunal ulcer		2
Phlebitis	1		Indeterminate		1
Died <sup>1</sup>	2		Gastric analysis (Groups 1 and 2)		
Results from 4 months to 3 years after operation			Combined acids (average)		50
Patients heard from	108		Free acids (average)		40
Cured	57	62	Operation		
Greatly benefited	10	11	Excision of ulcer		16
Slightly benefited	13	14	Excision of ulcer and appendectomy		25
Failure	19	21	Excision of ulcer and cholecystectomy		3
Total number benefited	80	87	Excision of ulcer appendectomy and cholecystectomy		1
Examinations			Excision of ulcer and gastro-enterostomy taken down		1
Roentgen ray			Excision of ulcer gastro enterostomy taken down and excision of jejunal ulcer		1
Cap deformed	12		Excision of ulcer appendectomy and gastro enterostomy		1
Duodenal ulcer	1		(Contact ulcer cauterized in 9 of the above cases)		
Duodenal ulcer with enlarged stomach	4		Lesion		
Negative	1		Duodenal ulcer		43
Gastric analysis			Duodenitis		3
Combined acids (average)	51		Ulcer and duodenitis		8
Free acids (average)	33		Gastric and duodenal ulcer		2
Postoperative details			Cholelithiasis		1
One patient developed gall stone colic several years after operation and the gall bladder was removed with relief of symptoms the duodenum was normal in appearance at the time			Gastrojejunal ulcer		1
Failures			Postoperative sequelae		
Operation for ulcer after 3 years details not known	1		Bronchitis		1
Gastro enterostomy elsewhere 3 years later, complete relief after operation	1		Pleurisy		2
Gastro-enterostomy elsewhere complete relief after operation	1		Infected wound		1
Deaths			Secondary hemorrhage		1
One patient died 4 months after operation Besides excision of ulcer the gall bladder containing stones was removed and the common duct explored and drained one stone being found in the ampulla The immediate cause of death was acute nephritis One patient died 7 months after operation The home			Pulmonary embolus and phlebitis		1
			Died 10 days after operation from peritonitis (ulcer had been excised and gastro enterostomy performed)		1
			Results		
			Patients heard from		30
			Cured		53
			Greatly benefited		20
			Failure (one gastric resection elsewhere three years later)		8
			Total number benefited		73
			Examinations		
			Roentgen ray		
			Cap deformed		2
			Duodenal ulcer		1
			Duodenal ulcer with enlarged stomach		2
			Gastric analysis		
			Combined acids		66
			Free acids		47

<sup>1</sup> Both patients died from bronchopneumonia one 14 days and one 11 days after operation. In one a gastrojejunal ulcer was excised the other case was uncomplicated



TABLE II—CASES OF THE THIRD GROUP (85)

	Number		Number
Men	50	Postoperative details	
Women	35	Careful of diet	33
Oldest patient	67	Not careful of diet	19
Youngest patient	18	Gained in weight	34
Average age	40	Normal weight	9
History previous to operation		Lost in weight	3
Average duration of symptoms	12	Hematemesis 15 months after operation	1
Typical of duodenal ulcer (12 with hemorrhage)	12	Examinations	
Typical of duodenal ulcer with other symptoms	4	Röntgen ray	
Not typical	10	Negative	2
Operations previously performed		Duodenum deformed	3
Appendectomy	20	Duodenum deformed and stomach enlarged	2
Gastro-enterostomy	1	Gastric analysis	
Appendectomy and cholecystectomy	2	Combined acids (average)	75
Appendectomy and pelvic operation	1	Free acids (average)	55
Suture of perforating ulcer	1		
Hernia	1		
Examinations			
Röntgen ray			
Duodenal ulcer	77		
Deformed cap	1		
Gastric and duodenal ulcer	1		
Obstruction	5		
Gastric analysis			
Combined acids (average)	69		
Free acids (average)	41		
Operation			
Gastroduodenostomy	20		
Gastroduodenostomy and appendectomy	48		
Gastroduodenostomy and cholecystectomy	9		
Gastroduodenostomy appendectomy and taking down gastro-enterostomy	1		
Gastroduodenostomy appendectomy and cholecystectomy	5		
Gastroduodenostomy appendectomy and cautery to contact ulcer	1		
Gastroduodenostomy and knife excision of contact ulcer	1		
Lesions			
Ulcers of anterior wall	69		
Multiple ulcers	4		
Ulcers of posterior wall	2		
Contact ulcers	6		
Gastric and duodenal ulcer	1		
Duodenitis	12		
Spastic pylorus	1		
Cholelithiasis	3		
Postoperative sequelæ			
Normal	79		
Pneumonia	2		
Pleurisy	1		
Phlebitis	2		
Died <sup>1</sup>	1		
Results from 6 months to 2 years after operation			
Patients heard from	59		
Cured	60		
Greatly benefited	16		
Slightly benefited	16		
Failure	7		
Died	1		
Total number benefited	92		

<sup>1</sup>Five days after operation. Acids, blood urea, calcium, etc. normal. No further treatment necessary.

The data in Tables 1 and 2 were taken from three groups of cases. In the first group the ulcer was excised without touching the pyloric sphincter. In the second group besides the excision of the ulcer, the pylorus was cut across but no portion of the muscle was excised (Table 1). These operations were all performed from 2 to 10 years ago. In Table 2 the data were obtained from a study of a group of cases in which the cap of the duodenum was excised together with the anterior portion of the pyloric sphincter. In studying groups of cases statistically we must keep in mind that there are many sources of error. The immediate results of this operation are very gratifying and convalescence is usually very smooth and free from vomiting, retention and gastric distress. The operation is carried out with the stomach and the duodenum open. With ordinary precautions against soiling the wound has healed well. Alvarez has studied a number of these cases 2 or 3 weeks after operation and has found that in some of them the stomach is a little slow in emptying. In all of the cases studied several weeks after operation the emptying time was normal. In no case has there been stricture or narrowing of the duodenum. The gastric acids are reduced after the operation but not quite to the extent that follows gastro-enterostomy. In most instances shortly following the operation the gastric acids were practically normal. In making roentgenological examinations after operation on the duodenum, one must bear in mind that the deformity which results from the operation is much the same as that which results from a duodenal ulcer, so that the roentgenologist

can be of very little service in deciding whether an ulcer has recurred in these cases. In some instances the roentgen-ray shows very little deformity.

Besides the cases reported here, excision of ulcer, partial resection of sphincter and gastroduodenostomy, have been performed in 120 additional cases, but too recently to justify

a report on the ultimate results. The immediate results have been just as satisfactory, with no mortality.

As a result of several years' experience with excision and partial duodenectomy, we believe that, when it can be satisfactorily carried out, it has distinct advantages over gastroenterostomy.

## THE ETIOLOGY OF EMPYEMA<sup>1</sup>

### HÆMOTHORAX IN IDIOPATHIC AND POSTOPERATIVE EMPYEMA

By DUFF S. ALLEN, M.D. ST. LOUIS, MISSOURI

THE factors which lead to the production of an empyema are not fully understood. Why does one patient develop empyema whereas a second patient with apparently an identical condition does not? This is an appropriate question in regard to all types of acute empyemata.

The purpose of this paper is to present a study of one of the etiological factors of empyema following intrapleural operations, namely, the relation between hemothorax occurring at the time of the operation and empyema following a thoracotomy in a chest not previously infected. In addition to this, we will discuss the relationship between spontaneous hemorrhage into the pleural space and the occurrence of idiopathic acute empyema associated with or following pneumonia.

### POSTOPERATIVE EMPYEMA

The risks which the patient who has had a thoracostomy or a thoracotomy encounters during the postoperative period are, of course, those risks which follow every major operation, but there are additional and unique risks which follow intrapleural operations. In the main, these special risks are those of asphyxia and empyema.

Asphyxia, when it occurs after an intrapleural operation, usually follows a thora-

costomy, such as in the early drainage of an infected pleural cavity, and, here like the asphyxia which may occur during the operation, it is the direct result of an open pneumothorax. It is at once evident that such postoperative asphyxia is not likely to be encountered in patients who have had their pleural cavities obliterated by adhesions or in whom the incision into the pleural cavity is firmly sutured at the end of the operation. In the latter cases—those with thoracotomy—the symptoms of asphyxia may result, however, from accumulation of any kind of fluid, postoperatively, in the pleural cavity.

The effects of postoperative asphyxia in cases with thoracostomy had not been thoroughly studied nor had their significance been fully recognized prior to the epidemic of influenza and empyema during the World War. The experimental work of Graham and Bell (6) emphasized the fact that when the vital capacity is low, such as is commonly found in an acute empyema associated with a pneumonia, the danger from asphyxia resulting from an open pneumothorax is present not only during the operation (thoracostomy) but persists throughout the days following the operation. In such cases, with low vital capacity, death

<sup>1</sup> The criticisms which were raised by many against the significance of this work have been answered and the original work has been extended in a recent Harvey lecture by Graham entitled "Alterations of Intrapleural Pressure and Their Significance." *Medicine* 1924 111 417.

<sup>2</sup> From the Department of Surgery, Washington University School of Medicine and Barnes Hospital, St. Louis.

from asphyxia is not an infrequent post operative result of the open drainage of the pleural cavity. The recognition of this fact has completely revolutionized the surgical management of acute empyema from a procedure which contemplated thoracostomy as soon as an infection of the pleural cavity was diagnosed to a procedure which advocates procrastination of open drainage until adhesions between the pleura of the lung and the costal pleura have effectively walled off the empyema or until the vital capacity has increased owing to the subsidence of the pneumonia.

Such rational procedures when applied to aspects of intrapleural surgery other than that for empyema should be and they have been of great value. The intentional production of adhesions between the costal pleura and the pleura of the lungs is often carried out before a thoracostomy or a thoracotomy is attempted. The vital capacity maintains its important rôle.

Empyema following uncomplicated thoracostomy or thoracotomy is unfortunately a serious and in all too frequent event. The causes for the occurrence of empyema after 'clean' operations upon the pleural cavity have not been fully recognized. Our experimental work reported here bears directly upon one of the causes of such postoperative empyema.

It has long been observed that a serious empyema follows thoracotomy with a much greater frequency than the frequency with which a serious peritonitis follows laparotomy. The occurrence of such an empyema has been variously ascribed to (1) the result of the open pneumothorax and its accompanying 'operative insults' to the pleura at the time of the operation (2) the result of excessive aspiration of bacteria during the operative procedure and, in thoracostomies of continued aspiration of bacteria after the operation had been finished, and (3) the result of a remaining closed pneumothorax after completion of a thoracotomy.

It is not our purpose to deny the possibility of the role played by any one of these three mentioned etiological factors in the production of an empyema following intrapleural operations but rather to stress the importance

of hemothorax as an etiological factor of empyema.

A brief elucidation of the above mentioned factors which have been considered most frequently as the causes for empyema following chest operations is necessary for the proper perspective to our experimental work reported here on the relationship of hemothorax to the production of empyema.

The effect of an open pneumothorax in the occurrence of empyema following a thoracotomy was first studied by Noetzel (12). In a comprehensive experimental study he found when bacteria were injected into the pleural cavity after an open pneumothorax had been produced by a thoracotomy that empyema followed much more rapidly and more frequently than when the same amounts of the same culture of bacteria were injected into the pleural cavity without the production of an open pneumothorax. He considered this difference in susceptibility of the pleura to infection to be due mainly to the effect of the air upon the pleura as well as to the possible deleterious effect upon the circulation within the lung resulting from a collapse of the lung itself. Tiegel (14) repeated these experiments of Noetzel and found similar results. He also considered the increased susceptibility to empyema following an open pneumothorax to be due to the effects of the pneumothorax such as drying and cooling of the pleura but, in addition to these to the mechanical insults to the pleura such as that due to rubbing by compresses or by the hand of the operator and to the trauma resulting from the careful wiping out of the blood in the pleural cavity. Tiegel noted the presence of a hemorrhagic fluid in the pleural cavity soon after the thoracotomy. He considered this hemorrhagic fluid to be the result of the infection in the pleural cavity. Our experimental evidence in contrast to this indicates that the blood had been present in the pleural cavity before the infection had been established and that this hemorrhage into the pleural cavity had aided in the establishment of the infection.

Aspiration of many bacteria into the free pleural cavity is possible in any operation which produces an open pneumothorax. We have not found the report of definite evidence



# EXPERIMENTAL HÆMOTHORAX AS AN ETIOLOGICAL FACTOR IN THE PRODUCTION OF EMPYEMA

## THORACOTOMY

The important rôle played by a hæmothorax in the production of empyema came to our attention first in our early experimental work for incision of the mitral valve (2). In the first series of the experiments 21 thoracotomies were performed of which the following experiment is typical.

*Experimental Series I* Exp 14 Under ether anaesthesia administered through the Gesell Erlinger intratracheal intermittent positive pressure apparatus the fourth left rib is removed subperiosteally from its posterior angle to the costal cartilage. The pleural cavity is opened widely and the left lung is packed away from the pericardium with a large sheet of moist silk. The pericardium is split over the base of the left auricular appendage and the left appendage is brought outside of the pericardium. The base of the appendage is clamped off with a specially constructed weak jawed right angled rubber jacketed clamp. The tip of the appendage is incised the end of the cardiocope is tied into the appendage and the clamp is removed from the base of the appendage. No bleeding follows. The lens of the cardiocope is pushed gently into the window which is inspected. A cusp of the mitral valve is identified by vision and grasped between the knife blade and the lens. The valve cusp is retracted and incised. Moderate bleeding takes place around the cardiocope. The lens end of the cardiocope is withdrawn into the left auricular appendage the appendage is ligated near its base and amputated. The pericardium is then sutured.

The silk sheet is now removed from the pleural cavity and the incision in the chest wall is closed. The pleura and periosteum form the first layer. They are closed by a continuous suture and just before the last stitch is placed the trachea is compressed around the intratracheal tube by the anaesthetist to expand the lungs fully and thus to drive out all the air in the pleural cavity. This increased positive pressure is maintained until

TABLE I—SERIES I, II, III AND IV

	Per cent of procedures	Total number individual experiments	Sealing of pleural cavity with blood	Incidence of empyema Per cent
Series I	Transauricular incision of mitral valve	21	Moderate	83
Series II	Transauricular incision of mitral valve	2	Slight	
Series III	Transauricular incision of mitral valve	2	Slight	14
Series IV	Transventricular incision of chordæ tendineæ	15	Marked	100

the muscle layer are overlapped to make the wound air tight. The wound is closed without drainage.

In this series of 21 experiments (Series I) empyema followed the thoracotomy in 18 instances 83 per cent (Table I).

*Experimental Series II* In the next 27 consecutive and similar experiments (Series II) for incision of the mitral valve (Table I) empyema followed the thoracotomy in only two instances 7 per cent. The same rigid aseptic careful technique had been followed in both Series I and Series II.

The sudden cessation of the occurrence of empyema was difficult to explain. A thorough investigation was made in both series of all the details connected with the operative procedure such as the methods for sterilization of supplies sanitation of cages preparation of the field of operation disease among the stock dog laxness on the part of the personnel variation in length of the duration of the open pneumothorax temperature and sanitation of operating room trauma to the pleura and the postoperative care of the animals. There had been no notable variation in any of the details in either of the two series certainly not enough to explain the sudden drop in the incidence of empyema from 83 to 7 per cent.

This experimental work for cutting the mitral valve was continued. Our primary



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The silk sheet is now removed from the pleural cavity and the incision in the chest wall is closed. The pleura and periosteum form the first layer. They are closed by a continuous suture and just before the last stitch is placed the trachea is compressed around the intratracheal tube by the anaesthetist to expand the lungs fully and thus to drive out all the air in the pleural cavity. This increased positive pressure is maintained until

TABLE I—SERIES I, II, III AND IV

	Experimental procedure	Total number of experiments	Soleing of pleural cavity with blood	Incidence of empyema
Series I	Trans auricular incision of mitral valve	21	Moderate	85
Series II	Trans auricular incision of mitral valve	27	Slight	7
Series III	Transauricular incision of mitral valve	22	Slight	14
Series IV	Transventricular ligation of chordæ tendineæ	18	Marked	100

the muscle layers are overlapped to make the wound air tight. The wound is closed without drainage.

In this series of 21 experiments (Series I), empyema followed the thoracotomy in 18 instances 85 per cent (Table I).

*Experimental Series II* In the next 27 consecutive and similar experiments (Series II) for incision of the mitral valve (Table I) empyema followed the thoracotomy in only two instances 7 per cent. The same rigid aseptic careful technique had been followed in both Series I and Series II.

The sudden cessation of the occurrence of empyema was difficult to explain. A thorough investigation was made in both series of all the details connected with the operative procedure such as the methods for sterilization of supplies sanitation of cages, preparation of the field of operation disease among the stock dogs laxness on the part of the personnel variation in length of the duration of the open pneumothorax temperature and sanitation of operating room trauma to the pleura and the postoperative care of the animal. There had been no notable variation in any of these details in either of the two series certainly not enough to explain the sudden drop in the incidence of empyema from 85 to 7 per cent.

This experimental work for cutting the mitral valve was continued. Our primary

object was the development of a practicable surgical procedure for the relief of mitral stenosis, but the experiments had taken on an added interest in that they served for the study of the occurrence of empyema following a thoracotomy in a pleural cavity which had not been infected before the operation.

*Experimental Series III and IV* A third series of experimental incision of the mitral valve (Series III) was begun in December 1922 (Table I). The same technique was followed as in Series I and Series II. Along with this Series III for incision of the mitral valve, a different operation was carried out upon the hearts of other animals (Series IV). In this, Series IV, a specially constructed needle, carrying a stout silk ligature, was passed blindly through the wall of the ventricle to encircle the chordæ tendineæ of the mitral valve, thereby producing a mitral stenosis (1). These two series of experiments, III and IV, were carried on at the same time and thus the thoracotomies of the one series were interspersed with the thoracotomies of the other series. A thoracotomy for the transauncular incision of the mitral valve performed on the one day was often followed by a thoracotomy for the transventricular ligation of the chordæ tendineæ of the mitral valve performed on the following day and this latter operation in turn was followed by the former operation on the third day etc.

Twenty-two experiments were done for cutting the mitral valve (Series III) of which only 3, or 14 per cent, were followed by empyema, 18 experiments were done for tying the chordæ tendineæ (Series IV) of which 18, or 100 per cent, were followed by empyema. The individual experiments had been interlaced the one with the other in the two series of similar thoracotomies, performed under almost exactly the same conditions of asepsis, with about the same duration of the open pneumothorax, the same opportunity for contamination of the pleural cavity with bacteria, practically the same amount of trauma to the pleura, and under the same extraneous conditions. Why should the one series of thoracotomies (Series III) be attended with empyema in only 14 per cent of the animals, while its concurrent series (Series

TABLE II—SERIES V

Exp No	Amt ham strepto coccus suspen sion Cubic centi meters	Autoc enous blood Cubic centi meters	Empyema	Killed or died	Days	Pleural culture
1	1	0	0	K	7	Sterile
2	1.5	2	Turbid fluid	K	1	Streptococcus hemolyticus
3	2	0	0	K	9	Sterile
4	1	0	++	D	8	Streptococcus hemolyticus
5	1.2	1	++	D	19	Streptococcus hemolyticus
6	1.4	0	Turbid fluid	K	1	Streptococcus hemolyticus
7	1	0.5	+++	D	8	Streptococcus hemolyticus
8	2	0	0	K	14	Sterile
9	1	2.5	++	K	7	Streptococcus hemolyticus
10	1	1	+++	K	45	Sterile
11	1.5	0	0	K	16	Sterile
12	1.1	2	++	D	22	Sterile
13	1	0	++	D	11	Streptococcus hemolyticus
14	2	2	+++	K	16	Streptococcus hemolyticus
15	1.1	0	0	K	12	Sterile
16	1.4	0	0	K	8	Sterile
17	1.2	0.5	+++	K	1	Streptococcus hemolyticus
18	1.0	1.0	++	D	10	Streptococcus hemolyticus
19	2	0	0	K	8	Sterile
20	1.5	0	Turbid fluid	K	1	Streptococcus hemolyticus
21	2	0	++	K	30	Sterile
	2.5	0	0	K	40	Sterile

IV) was being attended with empyema in every experiment 100 per cent? (Table I)

The high percentage of empyema following attempted ligation of the chordæ tendineæ of the mitral valve could not be accounted for by an impairment of the pulmonary circulation through the formation of a mitral stenosis since by the insertion of a needle blindly through the wall of the left ventricle to carry the ligature around the chordæ tendineæ the chordæ tendineæ had been missed or ineffectively encircled by the ligature in 6 of



TABLE III—SERIES VI<sup>1</sup>

Exp N	Attenuated Type IV Circumference	Amount of blood lost cc	Empyema	Killed or died	Days
1	1	0	0	N	3
2	1.5		0	N	32
3	1	0		N	3
4	1	5	0	N	
5	1.5	0		N	10
6	1			N	20
7	1	0		N	5
8	1	5	T. I. I. flu. I.	N	2
9	1			N	4
	1	2	0	N	
				N	6
	1		0	N	8
1	0			N	24
4	1.5	1.5		N	4
5	1	0		N	3
6				N	26

Plu. I. I. wa. to I. I. I. I.

the 18 attempts. These 6 animals had, therefore only a ligature passing into and out of the cavity of the left ventricle. Nevertheless they all developed empyema.

*Discussion of experimental Series I II III and IV.* An analysis was made of the four series of thoracotomies a total of 88 experiments. In Series I II and III (thoracotomy for the transauricular incision of the mitral valve) empyema had followed the operation in 18 of 21 experiments 85 per cent, in 2 of 27 experiments 7 per cent and in 3 of 22 experiments 14 per cent respectively. In Series IV, thoracotomy for the transventricular ligation of the chordæ tendineæ of the mitral valve empyema had followed the operation in 100 per cent of the 18 experiments.

A careful study of the records of the observations made during the various operations on the mitral valve revealed an unsuspected factor in those experiments for cutting the mitral valve by use of the cardioscope inserted through the left auricular appendage. In the first series of these experiments (Series

TABLE IV—SERIES VII

Exp N	Amount of blood lost cc	Autopsy now blood Circumference	Empyema	Killed or died	Days	Plural effusion
1	1.5		0	D	2	Pn. muc. u. Type III
	1	1	+	D	4	Pn. umorococcus Type III
3		0	0	D	5	P. umorococcus Type III
4	2	1	+	D	2	P. muc. u. Type III
5	1.2	0		D	3	St. I
6	1	1	+	D	1	Pn. umorococcus Type III

I) in which the thoracotomy had been followed by a high percentage of empyema 85 per cent a small drop of solder on the handle of the knife attachment of the cardioscope had allowed bleeding to take place around the cardioscope while the valve was being held between the lens and the knife blade (2) for inspection prior to incision and also while the valve was being incised. This hemorrhage had soiled the pleura. The blood had not been removed from the pleural cavity before closure of the thoracotomy wound.

The drop of solder had been removed from the handle of the knife after the completion of Experiment 20 in Series I. Following this, not more than 1 cubic centimeter of blood had entered the pleural cavity during the thoracotomy and incision of the mitral valve and the incidence of empyema following the thoracotomy had suddenly dropped from 85 per cent (Series I) to 7 per cent (Series II).

Likewise the soiling of the pleural cavity from hemorrhage during the operation had been marked in those experiments in which a needle had been passed from without into the cavity of the left ventricle (Series IV) for tying the chordæ tendineæ. The incidence of empyema following this operation in Series IV had been 100 per cent while the concurrent transauricular experiments for incision of the mitral valve in which there was but very little soiling of the pleura from hemorrhage had been followed by empyema in only 14

per cent of the experiments This seemed significant

From these results in the four series of a total of 88 thoracotomies we felt justified in the conclusion that soiling of the pleural cavity by hæmorrhage at the time of the thoracotomy had been a very important etiological factor in the production of the empyema which developed after the thoracotomy had been completed

This conclusion seemed to be a logical one Certainly the clotted blood in the warm moist pleural cavity should serve as an excellent medium for the growth of bacteria placed in an especially favorable environment for their growth We did not doubt that a hæmothorax resulting from the spilling of blood during a thoracotomy was an important factor in the production of the empyemata following such operations

We were not entirely convinced however that this conclusion would hold good for those cases of empyemata which occur spontaneously and which do not follow intrapleural operations

The effect of an open pneumothorax with its accompanying cooling and drying of the pleura, as well as the other "operative insults" to the pleura due to the unavoidable manipulations during the operations had *not* been followed by an empyema in most of these experiments in which there was but very little soiling of the pleura from hæmorrhage These factors, other than hæmothorax, might have been important contributing causes to the occurrence of the empyema which followed in those experiments in which fairly marked soiling of the pleura with blood had taken place during the operation If the empyema had resulted mainly from the presence of blood in the contaminated pleural cavity, then a pleural cavity into which bacteria had been injected and to which autogenous blood—and nothing else—had been added should be expected to develop an empyema in a high percentage of instances

Accordingly, a fifth series of experiments was begun which would bear directly on the subject of hæmorrhage in the pleural cavity as an important etiological factor in the occurrence of empyema

TABLE V — SERIES VIII

Exp No	Amount pneumococcus type I Cubic centimeters	Autogenous blood Cubic centimeters	Empyema	Killed or died	Days	Pleural culture
1	1	0	0	K	48	Sterile
2	1	1	+	D	5	Pneumococcus Type I
3	1 2	1 5	++	D	5	Pneumococcus Type I
4	1 6	0	0	K	10	Sterile
5	1	1	++	D	7	Pneumococcus Type I
6	2	0	0	K	6	Sterile
7	1 2	2	++	D	6	Pneumococcus Type I
8	1 2	0	+	D	7	Pneumococcus Type I
9	1 1	1	++	D	5	Pneumococcus Type I
10	1	0	0	K	27	Sterile
11	1	1 5	+++	D	7	Pneumococcus Type I
12	1	1	++	D	8	Pneumococcus Type I
13	2	0	0	K	68	Sterile
14	2	0	0	K	63	Sterile
15	1 2	1	++	D	6	Pneumococcus Type I
16	2	1 2	++	D	7	Pneumococcus Type I
17	1 5	0	0	D	12	Sterile
18	1	1	++	D	5	Pneumococcus Type I

#### EMPYEMA AFTER INJECTION OF BACTERIA AND BLOOD INTO THE PLEURAL CAVITY

*Experimental Series V* Twenty-two experiments were done in which a 24-hour blood-agar culture of a hæmolytic streptococcus, obtained from a patient with acute empyema, was injected into the pleural cavity of rabbits (Table II) Nine of these had, in addition to the bacteria, an amount of autogenous blood, from 0.5 to 2 cubic centimeters injected into the same pleural cavity All of these 9 developed an empyema (100 per cent) In 11 of the remaining 13 experiments in which no blood was intentionally injected into the pleural cavity the animals were allowed to live long enough for the development of an empyema Two were killed at the end of 24 hours Of these

11 control animals in which a suspension of bacteria in normal saline solution had been injected into the pleural cavity only three (27 per cent) developed an empyema. The remaining 8 were killed and at autopsy showed surprisingly normal pleura and lungs both when examined grossly and microscopically. None of the 8 had empyema (Table II).

The details of these experiments are shown in experiment No 17 August 19 1925. A rather blunt pointed needle is fitted to a hypodermic syringe filled with a suspension of hæmolytic streptococci. All bubbles of air are removed from the syringe and needle. The needle is passed through the skin of the right chest at about the level of the eighth rib. The point of the needle is then directed cradialward and comes to lie near the upper border of the eighth or ninth rib. The point is then dipped downward to pass below the posterior aspect of the rib. It is felt to pierce the pleura and is inserted 3 or 4 millimeters further while 12 cubic centimeters of the suspension of bacteria is being injected slowly into the pleural cavity. The needle is then withdrawn. A second syringe and needle is now employed. The needle is inserted between the ribs of the left (opposite) chest and 1 cubic centimeter of blood is aspirated from the heart. The original needle is reinserted into the right chest in exactly the same manner as before and 0.5 cubic centimeters of autogenous blood is injected into the right pleural cavity to act as a medium for the growth of the previously injected bacteria. The rabbit does not cough nor show marked respiratory distress. There is no hæmatoma or tumor mass palpable in the chest wall after the injection of either the suspension of bacteria or the blood. X ray shows hydrothorax (faint) but no pneumothorax.

August 20 Rabbit does not appear sick. Is hopping about the cage and appears to be as lively as its mates.

August 21 No change chest not dull to percussion.

August 24 Rabbit not lively. Chest not dull to percussion. X ray shows some fluid in left chest. No pneumothorax.

August 27 Rabbit visibly thinner. Looks haggard. Still fairly lively when one tries to pick it up. Chest percussion indefinite. Breath sounds heard over left chest but not nearly so loud as over right.

August 30 Rabbit looks unkempt does not eat but is fairly active. Chest as before.

August 31 Rabbit dead in cage.

*Autopsy.* Marked empyema with pus and fibrinous lumps over entire left pleural cavity. It seems incredible that such an extensive process would not have given more objective signs during life. No abscess of lung but pleura markedly thickened. Lung collapsed to  $\frac{1}{4}$  the size of the chest cavity. Enlarged glands  $\frac{1}{2}$  centimeter in length are found around the trachea. There is no abscess of liver or kidneys. The peritoneum is glistening everywhere. Culture Hæmolytic streptococci.

*Microscopical.* The cells of the serosa covering the lung can be made out in places. There is a fibrous exudate over the serosa which contains many polymorphonuclear cells and a lesser number of round cells. Beneath the serosa many polymorphonuclear cells are seen in the adjacent alveoli. There is marked atelectasis of the alveoli near the periphery.

The relative frequency of the occurrence of empyema after injection of the hæmolytic streptococcus alone and the same hæmolytic streptococcus plus 1 to 2 cubic centimeters of autogenous blood into the chest of a rabbit is shown in Table II. If a small quantity of blood were added immediately to the pleural cavity which had been contaminated by the hæmolytic streptococcus empyema followed in every instance. The controls in which no blood was added to the suspension of hæmolytic streptococci showed a lower percentage of empyema.

In these experiments in which blood and hæmolytic streptococci were carefully injected into the pleural cavity with a syringe, there was no complicating open pneumothorax and hence drying and chilling of the pleura could not have been responsible for the resulting empyema. Likewise there had been no thoracotomy with its opportunity for mechanical injury to the pleura. The experiments added a definite proof therefore that hæmorrhage into the pleural cavity had been an important factor in the production of empyema following those intrapleural operations in the Experimental Series I II III and IV.

#### HYMOTHORAX AS AN ETIOLOGICAL FACTOR IN THE PRODUCTION OF ACUTE EMPYEMA DUE TO THE PNEUMOCOCCUS

It seemed reasonable to infer from the above discussion and experimental facts obtained with the streptococcus that blood in the pleural

cavity which was contaminated by the pneumococcus would also produce an acute empyema

This appeared to be worthy of experimental investigation

Accordingly, the sixth series of these experiments was carried out. A suspension in normal saline solution of a 48 hour blood agar culture of the pneumococcus, Type IV, was injected into the pleural cavity of 16 rabbits, by the same technique as was used in the hæmolytic streptococcus series. One to 2 cubic centimeters of autogenous blood was injected into the chests of 8 of these 16 rabbits. The remaining 8 animals were allowed to live as controls. Not a single one of the 16 rabbits developed an empyema. None of them died following the injection of pneumococcus, or pneumococcus and blood into the pleural cavity. The pneumococcus used in this series, however, had been grown on artificial media in the laboratory for several months prior to its use for inoculation and it had therefore lost its virulence.

The series is included here only for its value as a control for the remaining experimental series. It shows that the aspiration of blood from the heart and the presence of blood alone in the pleural cavity of this series (VI) and similar experiments (Series V, VII, and VIII) would not be expected to cause the death of the animal or to lead to the formation of an empyema. Empyema following the injection of blood and bacteria in other experiments is evidently due to the combined effect of the bacteria aided by the presence of the blood in the pleural cavity.

*Series VII Experiments with Pneumococcus, Type III* Another series of experiments (Series VII), was carried out in which a virulent pneumococcus, Type III, was injected into the pleural cavity of 6 rabbits. In 3 of these 1 cubic centimeter of autogenous blood was also injected. All of these 6 rabbits died within the following 5 days. Only the 3 rabbits, however, in which blood was added to the pleural cavity containing the pneumococcus showed an empyema at autopsy. The 3 controls, in which pneumococcus alone had been injected into the pleural cavity, showed a surprisingly normal pleural space at

autopsy. There was no empyema in either of the 3 controls, although the pneumococcus was recovered from the surface of the pleura in 2 of them. The heart's blood contained pneumococci in one of the controls. They died of a pneumococcal septicæmia. The results of this series of experiments are shown in Table IV.

*Series VIII Experiments with pneumococcus, Type I* A suspension, in normal saline, of a 36 hour blood agar culture of an unattenuated pneumococcus, Type I, was injected into the chest cavity of 18 rabbits. The same technique was used in this series of experiments for injecting the bacteria into the pleural cavity as had been used in the preceding series. Likewise, the particles of agar were carefully removed from the suspension by the centrifuge.

In 10 of these 18 experiments, from 1 to 2 cubic centimeters of autogenous blood was injected into the pleural cavity immediately after the introduction of the pneumococci. The remaining 8 animals were used as controls.

The animals selected for these experiments were all of almost equal size, the same species, and had lived in the same surroundings since birth. They were young, full grown rabbits. They were kept in pens in the one room after the pneumococci or pneumococci with blood had been injected into the pleural cavity. Each rabbit received the same kind of food at all times.

The results of this series of experiments were very striking (Table V).

Every rabbit in which blood was introduced into the pleural cavity along with the pneumococci developed empyema and died. In those rabbits in which like amounts of the suspension of pneumococci were introduced without the intentional introduction of blood, only 2 of the 8 died, and only 1 of these 2 had empyema. At autopsy, it seemed very evident that this 1 control rabbit had had bleeding into the pleural cavity from the needle wound. The remaining 6 control animals were killed and none was found to have developed an empyema.

The results of this series of experiments are shown in Table V.

## CLINICAL OBSERVATIONS

HEMORRHAGE INTO THE PLEURAL CAVITY AS  
AN ETIOLOGICAL FACTOR OF IDIOPATHIC  
EMPHYSEMA DUE TO THE STREPTOCOCCUS

The series of experiments in which hemolytic streptococci were obtained from a patient with acute empyema and injected into the normal pleural cavity of rabbits along with a small amount of blood serve not only to demonstrate the important role of hemorrhage into the pleural cavity in the production of empyema following intrapleural operations but in addition they indicate the probability that an acute empyema following or associated with a pneumonia may be established in truth by the spontaneous occurrence of hemorrhage into the pleural cavity. There are abundant opportunities for the extrusion of blood into the pleural space in cases of pneumonia from causes such as the rubbing together of the inflamed pleural surfaces—which are often covered with granulation tissue—or perhaps through rupture of a small vessel of the inflamed pleura as the result of violent coughing.

The causes of the occurrence of acute empyema following or associated with pneumonia are usually considered to be due (a) to the extension of the infection to the pleural surface through blocked lymphatics (5, 8) and (b) to the rupture of a subpleural abscess into the pleural space (10). We do not wish to doubt the probability of either of these causes. Rather we hope to point out the fact that the development of an acute empyema may be the result of a spontaneous hemothorax which has become infected. The presence of septicæmia in patients who have pneumonia makes it possible for the bacteria to be carried into the pleural space through the blood stream itself. Bacteria may reach the pleural cavity however directly from the lung.

Whether hemorrhage into the pleural cavity actually does occur to instigate the formation of an acute empyema as it is met with in patients is not proved of course by these experiments in rabbits. They do indicate however that if such hemorrhage were to take place into the pleural cavity empyema would be far more likely to be the result

than if there were no free blood in the pleural cavity.

It is at once apparent that the question as to whether intrapleural hemorrhage does take place in patients who later develop a streptococcus empyema can be ascertained only through observations made upon such patients themselves. Two cases of empyema due to the hemolytic streptococcus developed in the Barnes Hospital at the time when this investigation had reached this point. The usual diagnostic aspiration of the pleural cavity was carried out in each instance as soon as the presence of fluid could be suspected from the clinical and physical signs combined with X-ray and fluoroscopic examinations. The fluid obtained from the infected chest cavity in this early stage in the development of the acute empyema was of a bloody color and contained myriads of laked red blood corpuscles. There could be no doubt in either patient that the fluid in the chest cavity contained blood.

The fact that bloody fluid may be aspirated from the pleural cavity in patients who are developing an acute empyema due to the streptococcus is so well known that it needs no further elaboration. Everyone who has observed such cases must have observed this fact. In the streptococcus empyema associated with the epidemic of influenza during and immediately following the World War bloody fluid was aspirated almost universally during the first days of the development of the infection in the pleural cavity (9). The significance of this finding does not seem to have been fully appreciated. When this fact is viewed in the light of our experimental work however one can not escape the conclusion that the blood in the pleural cavity was an important etiological factor in the production of these acute empyemata in which the hemolytic streptococcus was the infecting organism.

HEMOTHORAX AS AN ETIOLOGICAL FACTOR IN  
THE PRODUCTION OF IDIOPATHIC EMPHYSEMA  
DUE TO THE PNEUMOCOCCUS

We have seen in patients that there is definite clinical evidence that blood is present in marked amounts in the earliest stages of the development of a streptococcal empyema.

Likewise, we must seek the patient for evidence of the presence of blood in the pleural cavity at the beginning of the development of an acute pneumococcal empyema. Does hæmorrhage into the pleural space really occur in these cases which develop an acute pneumococcal empyema? If it does, then, in the light of these experiments, we must conclude that it could have been very instrumental in the production of the full blown empyema.

Perhaps the best evidence of the presence of blood in any cavity is the presence of large amounts of red blood cells.<sup>1</sup> In the early stage of an acute streptococcal empyema, this is indicated by the reddish brown color of the fluid. In acute pneumococcal empyema, however, one seldom finds red or brown fluid. Instead, the fluid aspirated from the pleural cavity in the early stages of these cases is usually of a greenish tint. This, nevertheless, is significant. The green color is due to a derivative of the hæmoglobin of the red blood cells—methæmoglobin or an isomer of methæmoglobin (4). The presence of the greenish color in the fluid which is aspirated from the pleural space early in the development of acute pneumococcal empyema is proof of the presence of blood.

This evidence of the presence of blood in the pleural cavity in the early development of pneumococcal empyema is almost always present. Furthermore, at necropsy, in a patient dying of pneumococcal pneumonia, not infrequently the pleura of the lung is covered or replaced by granulation tissue, and often the pleural cavity contains several cubic centimeters of bloody fluid (6). The experiments with the hæmothorax which were intentionally contaminated with virulent pneumococci indicate the facility with which this bloody fluid could be changed into an empyema by a contamination with pneumococci in any manner.

#### SUMMARY

The risks met with during intrapleural operations, in cases in which the pleural space is not obliterated by adhesions, are chiefly those which attend asphyxia. The vital capac-

ity obtained before operation is a reliable index for the danger from asphyxia which will be encountered during and after the operation. Dependable apparatus for artificial respiration should always be available for such operations.

The postoperative risks in patients with intrapleural operations are of more consequence than those occurring during the operation. Postoperative asphyxia in thoracotomies for empyema should be guarded by a procrastination of the operation until the vital capacity has risen safely above the tidal area.

Postoperative empyema in chests not previously infected may be the result of trauma to the pleura (mechanical), or drying and chilling. It may also be the result of a hæmothorax.

A total of 150 experimental observations are recorded in this experimental series. In 40 experiments, moderate or excessive hæmothorax with excessive contamination by virulent micro organisms occurred, in 40 animals, 100 per cent, empyema developed. Twenty-four control animals were given the same excessive contamination of the pleural cavity with virulent organisms, but without intentional hæmothorax, 3 of these, or 12 per cent, developed empyema. Twenty-one animals had moderate hæmothorax with contamination by micro organisms at careful "aseptic" thoracotomy, 18, or 85 per cent of these animals, developed empyemata. Forty-nine animals had "aseptic" thoracotomy with slight hæmothorax, 5, or 10 per cent, of these developed empyemata. The pleural cavities of the remaining 16 experiments were contaminated by an attenuated pneumococcus with and without hæmothorax but none developed empyema.

These experimental results indicate the important role played by the hæmothorax, acquired during a thoracotomy, in the production of empyema following the operation. Hæmorrhage into the pleural cavity can be controlled by careful attention to hæmostasis before the pleural cavity has been opened and during the intrapleural procedures. This should be done.

The early stages of idiopathic, streptococcal, and pneumococcal empyemata usually show

<sup>1</sup> Red blood cells are normally present in the pleural cavity but in relatively small numbers.

evidence of hæmothorax. In view of this experimental data the probability is evident that idiopathic empyema is engendered, in truth by a preceding spontaneous hæmothorax. The clinical evidence for this probability is abundant.

#### CONCLUSIONS

1 Postoperative complications of intra pleural operations are often more serious than those complications which may arise during the operation.

2 Postoperative empyema may be the result of a hæmothorax acquired during the thoracotomy or thoracostomy.

3 Hæmostasis should be complete before and after the pleural cavity is entered.

4 Idiopathic empyema may be ushered in by a spontaneous hæmothorax which is or becomes infected with the pneumococcus or the streptococcus.

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## THYROID AND PARATHYROID BONE TUMORS WITHOUT PRIMARY LESION OF THE THYROID GLAND<sup>1</sup>

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IT is well known that tumors of thyroid origin have a striking predilection to metastasize to bones, in fact, malignant growths of the thyroid, breast, prostate, and suprarenals metastasize to the skeleton much more often than do any of the other types of malignant tumors.

In Schmidt's (19) statistics the relative frequency with which the various neoplasms involve the skeleton is so represented, mammary gland, prostate, thyroid, stomach, more seldom the uterus and gall bladder, still more seldom, the liver, urinary bladder, ovary, bronchi, and pancreas. Tumors of suprarenal type are not mentioned, but we know today that they frequently metastasize to bones.

It is also worth remembering that while prostate and mamma cancers metastasize to the lymph glands, pleura, lungs, and liver even more often than to bones, epithelial tumors of thyroid as well as those of suprarenal origin can sometimes metastasize only to osseous tissues. More than that, it has been noted that a total thyroidectomy generally performed in cases of malignant tumor can be followed by no severe signs of hypothyroidism because of the presence of osseous nodules of thyroid tissue, which not only reproduce the glandular structure of the organ but also elaborate the same specific secretion.

Such a property so marked in cancers of the thyroid has often been noted also in benign tumors of glandular types, in thyroid adenoma.

But it must be remembered how difficult the diagnosis can be, especially the histological one, between a thyroid adenocarcinoma and a simple adenoma, to understand why some authors have denied the existence of benign "metastasizing goiters" and have held the presence of metastasis as a sure proof of malignancy of the primary tumor.

The histological study is often performed on a single specimen of the removed tumor,

while it is well known that evidence of malignancy can be found in a limited area, hence the necessity of examining many sections drawn from various places.

It is also well known that cases have been reported of secondary growths in bones in which the lesion was not to be considered either clinically or anatomically as a real thyroid neoplasm not even benign, but all characteristics led to the diagnosis of simple colloid or hypertrophic goiter.

Here I must emphasize the difficulty generally of distinguishing clinically rather than anatomically a simple hyperplastic goiter or often a hyperplastic and degenerative one from a thyroid adenoma.

Also we must remember that many authors have shown the possibility of a malignant change in a goiter limited to a small space of the enlarged gland. Therefore, thorough histological study is necessary, because this neoplastic area can easily be overlooked in an incomplete examination. There are in the literature reports of many cases of simple goiters with secondary reproductions in bones, and what is more important, with neoplastic development of these metastatic growths sometimes frankly malignant, while the primary enlargement of the thyroid gland appeared as a simple goiter or did not recur when operated upon.

Given the aforementioned difficulties of a sure diagnosis between a simple goiter and a benign tumor, we may take these cases into account together and study the possibility of metastasis in benign lesions of the thyroid gland (goiters and simple adenoma).

A lot of other cases that I will not enumerate have been published since Cohnheim reported the first case of multiple metastases to the lungs, bronchial lymph nodes, and bones. In his case the histological study of the enlarged thyroid showed a colloid goiter and a similar structure in the secondary growths.

<sup>1</sup>Read before the Clinical Congress of the American College of Surgeons Montreal October 1926



Simpson (22) in a very interesting paper recently published gathers 77 such cases but he also acknowledges that probably other cases have been reported which he has not seen. In a recent paper of mine (3) I think that I have succeeded in demonstrating that several cases which were reported as bone endothelioma were really secondary tumors of thyroid (or suprarenal) type often with seemingly benign primary lesions of the gland.

Many hypotheses have been advanced to explain this behavior which does not conform to the accepted doctrines of the pathology of malignant as compared with benign tumors and with the simply hyperplastic or degenerative lesions such as the so called goiter.

The theory accepted with most favor is that which seeks to prove the possibility of embryonal aberrations and of the formation of foci of thyroid tissue in abnormal sites. These at a certain time of life generally more or less late can give place to structures with a progressive development of neoplastic type. This theory which is connected with that of Durante Cohnheim on the origin of tumors in general, certainly applies to some common types in which localization of residual thyroid occurs. These are not always real embryonal aberrations as for instance tumors of the foramen cecum of the tongue or in the lateral regions of the neck. Therefore the theory could be reserved to explain development in certain bones in the neighborhood of the neck, especially in the region of the lower jaw and perhaps also in the region of the clavicle and of the sternum.

But it is difficult to accept this theory in case of multiple and distant localizations, more so as the relation of thyroid lesions such as adenoma or simple goiter to the evolution of these secondary nodules does not clearly appear. It would seem that in the postnatal life these secondary nodules would be entirely independent from the thyroid gland.

It must also be taken into account that tumors may develop in accessory thyroids and metastasize because the primary tumor can be easily overlooked and the thyroid gland in its normal site shows no enlargement.

Honsell (9) denies the fact that accessory thyroids could give place to neoplasms, al-

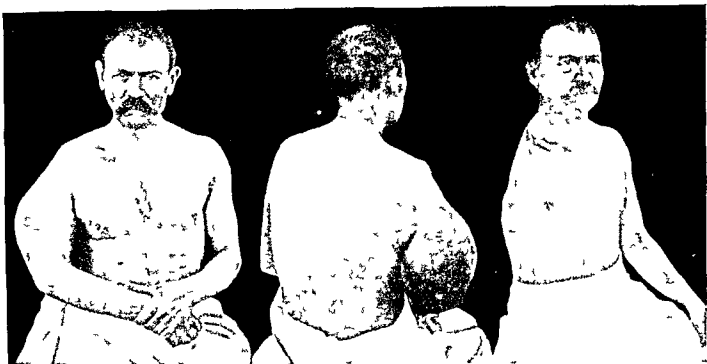
though I cannot understand the basis of such an assumption, because it is a generally accepted doctrine that neoplasms can easily arise in aberrant tissue, and as regards accessory thyroids there are the well studied cases reported by Barnabo (4) and Tron (23) and the cases reported by Lenzi and Martini (quoted by Barnabo) which deal with the development of simple goiters from accessory thyroids. Similar to these is Hollis' (8) case (after Henderson).

Accessory thyroid is to be found in the neck at the base of the tongue and in the mediastinum. The last two localizations are the most important as thyroid so placed is apt to be overlooked at a routine examination.

A typical case of adenocarcinoma developed from accessory thyroid with metastasis in the head of the humerus has been operated on by Ceci and reported by Saviozzi (19).

Another hypothesis seeks to prove that cells may enter the blood stream and become transplanted at distant sites in cases of both benign tumors and hyperplastic conditions of the thyroid. The theory is founded on the anatomical structure of the thyroid especially on the close relations between the glandular tissue and the blood vessels and above all the veins particularly in cases of hyperplasia of the gland. Hence, the easy growth of cells inside the vessel and the passage in the circulation of emboli, made up of masses of cells which can get to the right auricle pass through the lungs and dart into the main circulation. Oderfeld and Steinhaus first paper (13) deals with this point. In the bone marrow they would stop because of the slowness of the circulation and grow by favorable not well defined conditions which can be inferred from the predilection of thyroid skeletal metastasis in malignant growths of the gland. In these new conditions of life one must grant that these cellular complexes of benign neoplastic type or simply of hyperplastic type, could take an atypical progressive turn.

Pieri (16) writing about bone metastasis of thyroid cancer lays great stress upon the special type of lacunar circulation of the bones which leads to a lowering of the blood speed and favors the implantation of the circulating



Figs 1 and 2 before operation, and Fig 3, after operation in Case

cellular elements. He quotes Vanzetti (24) who, working on thyroid grafts, has shown that the most suitable ground for the development of thyroid tissue is the bone marrow. Joll (10) agrees with him and he refers to the observations of Piney (17) who compared the well formed blood vessels of the yellow marrow with the more numerous, thin walled capillaries of the red. He came to the conclusion that the cells or cellular masses tend to stop along the vessel walls as they pass from the circulation of the yellow marrow to the broader one of the red. The same thing happens under similar circumstances to the leucocytes.

In my paper on skeletal metastasis in hypernephroma I have noted that similar conditions in suprarenal tissue, in the capsule of the kidney, and in the aberrant nodules of the kidney support this hypothesis, which has been advanced to explain similar cases of osseous tumors with thyroid or suprarenal structure.

I do not wish to examine further these two hypotheses, but rather to consider the previously mentioned question of progressive and invading osseous thyroid tumors, sometimes several in number, with secondary metastases, and every evidence of malignancy

but without a primary malignant tumor of the thyroid gland. Do they really exist or are the related cases simply errors resulting from excessive haste in reporting the case or incomplete examination of patients?

Simpson's already mentioned paper is worth reading in this connection. He upholds the opinion that these are malignant tumors not only with several cases gathered in the literature but also with 3 really demonstrative personal ones. The second of these had been reported in 1913 by de Nancrede as a case of metastasis of fetal thyroid tissue in the femur. Instead, Simpson has been able to prove that the patient died 18 months afterward owing to the rapid growth of an irregular, hard goiter, which infiltrated the neighboring neck tissues and caused progressive signs of dyspnoea, dysphagia, and aphonia, in other words death was certainly due to a carcinoma of the thyroid gland.

Quite similar to this is the case of thyroid tumor of the frontal bone reported by Oderfeld and Steinhaus, they thought it possible that normal thyroid cells had passed into the blood stream, but as it appears from a second paper by the same authors (14), within 6 months a local recurrence occurred, the right thyroid lobe had undergone considerable



Fig 4 Photomicrograph Case 2 showing round ovoid or irregular cavities



Fig 5 Photomicrograph Case 2 showing another area

enlargement and there appeared secondary nodes on the right temporal bone and on the sternum. Death ensued. A partial autopsy was done and it was recognized that the primary tumor was the one of the right thyroid lobe.

Simpson concludes that there is no such entity as the benign metastasizing goiter and that this term should be abandoned. I am able to report a case which has many points of similarity with the preceding ones and which can support this theory.

**CASE 1.** T. A., a woman 41 years old, was operated on by myself in February, 1913. A right extra capsular hemithyroidectomy was done under the diagnosis of hyperplastic goiter. The right thyroid lobe had undergone an enlargement 3 years before



Fig 6 Case 2

A small portion of the superior lobe was left in place. The histological examination supported the clinical diagnosis. In 1918 the woman came to me complaining of severe pains in the upper portion of the right thigh. A diagnosis of sciatica had been made and various treatments tried without success. Clinical examination of the bone and hip joint were negative but as the symptoms were not those of a usual sciatica and there was pain at pressure on the trochanter I suggested a skiagram. This was done only after some time when while in bed the patient got a spontaneous fracture of the upper femoral end. The radiogram showed the neoplastic nature of the bone lesion. As clinical and radiological examinations were negative for other localizations especially in the bones, lungs and liver in October, 1919 I resected the upper end of the right femur. Microscopic study of the tissue revealed an adenocarcinoma of the thyroid type. Convalescence was uneventful but within 1 year the patient experienced pains in the opposite side. Notwithstanding this she did well 3 years and with an orthopedic appliance she could walk. Death occurred in April, 1926 following local recurrence and metastasis. During all this time no suspicious nodules were detected in the right half of the neck nor did anything noteworthy appear in the left lobe of the thyroid. In this case the microscopic study of the goiter removed in 1915 did not reveal any malignant structure; it agreed in this way with the clinical history of the patient and with the diagnosis. However I must recognize the fact that the pathological examination was limited to the macroscopic appearance of the removed piece of tissue to the raw cut surface and but a few sections from a small area microscopically examined.

The further evolution—the metastatic growth in the upper end of the right femur followed by spontaneous fracture and recurrence after resection—the development of other metastatic nodules which lead to death—gives great weight to the idea although it is not certain that the case was one of malignant



Fig 7 Case 2



Fig 8 Case 2

primary neoplasm of the thyroid gland. The removed thyroid lobe was not preserved.

But it is not possible to explain in this way every case and I think the question not yet solved.

There are indeed cases in which no change of the thyroid gland is present, not the slightest enlargement (goiter), in these the exclusive explanation referring to a malignant primary tumor of the thyroid gland cannot be accepted.

I have observed and operated on 2 such cases, and from this point of view they look particularly interesting. Zapelloni (26) made a thorough search of the literature to 1913 and weighed every case with great care, excluding the simply doubtful ones. He collected 4 other cases, that of Riedel (18), lower jaw, Becker (5), clavicle, Serafini (21), upper jaw, and of Guibe (7), clavicle. To these I think that we ought perhaps to add Beilby's case, upper jaw, reported by Kanoky (11). Some of these cases, however, have been followed for a short time only.

I refer the reader to Zapelloni's paper for more details. I will confine myself to the report of my 2 cases because they have been followed up for a long time and studied from every point of view.

Both cases have already been published by D'Urso (6) who operated the first time on the first case, by myself (1, 2), and in the already mentioned paper by my assistant Zapelloni, who made a thorough histological study, so I shall add only a short resume of the

clinical histories together with the histological findings.

CASE 2. Q. A., from S. Donato (Caserta), male, laborer married, with 7 sons age 51 years in 1905. Personal and familial history irrelevant. He had malaria when 28 years old. Patient denies lues and venereal diseases.

In 1895 the patient fell on the right shoulder and within a year sustained another trauma of the same region, which was followed by a certain amount of limitation of motion of the right upper limb. In 1898 he fell again on the same shoulder and an enlargement of the bone followed. For this he was admitted to the Surgical University Clinic. On physical examination a big tumor on the upper end of the right humerus extending to the insertion of the deltoid muscle was felt. It was in some places of elastic hardness, in others of elastic softness and there were places where it fluctuated, in other places egg shell cracking was noted, it was pulsating on its antero-



Fig 9 Case 2

external surface. Radiograms revealed a conspicuous enlargement of the head of the humerus and of the upper third of the diaphysis which below the insertions of the deltoid muscle appeared normal. The glenoid cavity and the other bones of the shoulder joint appeared normal.

Complete examination failed to reveal anything noteworthy. The thyroid gland was normal.

Under the diagnosis of myelogenous sarcoma of the upper end of the humerus a resection was performed by D Urso on May 6 1898. The patient did well for 21 months. In this time he noticed a knot as big as a nut deeply embedded in the soft parts near the humeral stump—a removal of it was suggested but as it did not give him any trouble he refused. The node slowly and gradually increased in size until it invaded the whole posterior region of the arm and the axillary region. He then sought surgical aid and was admitted in my division in the Polyclinic in April 1905. He stated that recently the growth had increased more rapidly.

The biggest tumor (Figs 1 and 2) occupied the upper portion of the arm and was connected with the humeral stump. It reached with a big irregular node the axilla which was completely filled and with other nodes not well defined the pectoral subspinous and supraspinous muscles. The skin on the external and posterior surface of the arm and partly also on the external part of the scapular region was dark red and bruised because of the undergrowing tumor and ointments used by the patient. The anterior surface of the arm and the chest was normal only many conspicuously enlarged subcutaneous venous vessels could be seen.

The whole mass was soft and in some places fluctuated. The surface was irregular and pressure did not elicit any pain. It was not pulsating. Because of the impossibility of examining the arm pit no enlarged lymph nodes could be noted in the subclavicular and supraclavicular region or in the lateral chest wall. No active motion was present but a certain degree of passive motion was possible. The scapula was felt following the movements of the limb. Complete examination did not reveal anything noteworthy. The lungs were normal. The thyroid gland was perfectly normal.

As a simple removal of the growth was impossible I performed April 8 1905 an interscapular thoracic disarticulation. The postoperative course was uneventful (Fig 3). After 1 year I saw the patient again. There were no recurrences. The thyroid gland was always quite normal. I have not been able to follow up this patient.

A particular microscopic and macroscopic description of the tumor removed in 1898 by D Urso can be found in D Urso's paper published in 1900. I refer the reader to it. He thought at the time that the tumor was a lymphangio-endothelioma.

Zapelloni has given a minute account of the piece that I removed and to this also I refer the reader. The tumor was composed of various nodes some very big. One was as big as a cedar fruit and was

embedded between the vastus externus and internus of the triceps and the long head of this same muscle. Others were the size of an almond or still smaller one was closely adherent to the shaft of the humerus which was at this point invaded by the tumor and fractured.

Generally speaking the nodules were more or less round shaped with a coarsely lumpy surface and well limited by a capsule, so that each mass could easily be enucleated from the neighboring tissues. The capsule was of varying thickness pink where it was thicker dark red or dark green where it was thinner and the tissue underneath could be seen. The masses were soft somewhat fluctuating. On section the structure was cystic and nodular. The cysts were of various sizes some scarcely visible to the naked eye others almond sized. Some were filled with dark non glutinous homogeneous jelly like substance others with similar material but reddish or greenish. The nodules were also of different size but were rather horny of variable color from yellow pink to yellow brown. The cysts and the nodules were separated from each other by a net of connective tissue which originated in the capsule. In the center of the biggest masses a strand could be seen passing directly into the surrounding neoplastic tissue. It had a glassy appearance and was firmer because it did not contain cystic cavities.

Microscopically the tumor was composed of two different tissues. The first vesicular tubular or alveolar with a colloid secretion inside most of the vesicles and tubules. The cavities were lined with cuboid or cylindrical rather small cells. These had a dark protoplasm and were arranged as an epithelium. The second was tubular or alveolar and had no colloid secretion and its cells were larger polyhedral or cylindrical with a light protoplasm. They were also arranged as an epithelium.

The former type was more widely scattered and was made up of round shaped ovoid or irregular cavities. These were lined by a layer of generally dark elements and were filled with a homogeneous notched structureless mass which took different colors with different dyes. Pink with the eosin red with the scarlet yellow with the Van Gieson's orange reddish with Mallory's bright red with Traub's dye (Fig 4). In another area the structure was somewhat different as the vesicles were gathered around a blood vessel with their greater averseness to it in such a way that in some places thin connective tissue septa could be seen proceeding from the outer coat of a transversely sectioned vessel and making a network with more or less triangular meshes each one holding a vesicle (Fig 5). In other places these dark cellular elements were arranged so as to form tubular or band like structures anastomosed between themselves sometimes with an irregular opening or so as to form alveolar structures as cellular nests of a connective tissue network.

The latter type of tissue with its light polyhedral elements has a tubular or an alveolar structure. It



Fig. 10 (left) Roentgenogram of the neoplasm in Case 3  
 Fig. 11 Roentgenogram 60 days after operation

is characterized by the thinness of its connective tissue fibers and by its supply of broad and varicose capillaries. In some places we found thick strands of polyhedral, light cells, separated by thin connective tissue septa or by a capillary vessel, often anastomosed to each other.

In the strands the cells were directly and irregularly placed one against another, only a few areas were to be seen where the cells took a sort of columnar disposition with the nuclei displaced toward the axis of the strand (Figs. 6 and 7). Along the axis of the broadest strands there were often rather cylindrical cells circularly placed around a small space so as to form a vesicle which was not surrounded by any membrane. There were also broad tubules lined by a single layer of high columnar light cells (Figs. 8 and 9) which on transverse or oblique section had the appearance of vesicular structures. These regularly bored tubules (100 micromillimeters) had a tortuous course and twisted themselves together and formed a compact mass divided into irregular lobules by vessels and connective tissue bands.

The cysts visible to the naked eye were partly hæmatic with a connective tissue wall partly filled with an amorphous and microchemically colloid like substance, like that found in the microscopic vesicles. In these an epithelial lining more or less preserved was found. The cells were those of the dark type only more flattened in places, pluristratified with shallow intracystic papillary growth.

From this description, it can be seen that the first type of tissue, where it has a vesicular structure, perfectly imitates the thyroid tissue in its mono-

stratified epithelial lining of the vesicles and in the irregularly edged, microchemically colloid like substance which fills them. In the different fields it looks like embryonal thyroid tissue like adult gland, thyroid adenoma, and also like thyroid carcinoma.

The other type, especially in its alveolar areas with irregularly polyhedral neatly defined cells whose central well eosin stained nuclei have plenty of chromatin, imitates the corticoadrenal element and still more the fundamental element of the parathyroid glands.

The behavior of the elements between these cells, the connective tissue, the vessels, and many other features, which are discussed at length in Zapelloni's paper, and above all the close contiguity to thyroid tissue all lead to the conclusion that these areas represent a tissue of parathyroid type.

Hence the histological diagnosis of mixed thyroid and parathyroid adenocarcinoma.

CASE 3. B. M., age 21 years (in 1912), was a student from Rome. The familial anamnesis was irrelevant. The patient had had when young typhus, bronchitis, and scarlet fever, and afterward had always enjoyed good health until September, 1910. At this time he began to complain of sharp, shooting pains in the right forearm; the supination and pronation of the forearm sharpened the pain to such a point that these movements were very limited. When the pains subsided a feeling of weakness followed. Physical examination was negative. No fever occurred. These conditions lasted from September to December, then the symptoms disappeared and the patient did well until September,

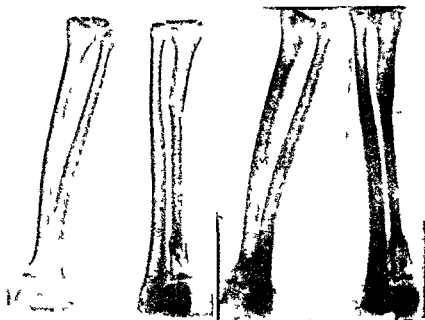


Fig. 12 (left) Roentgenogram 224 days after operation

Fig. 13 Roentgenogram 19 months after operation

1911 when he began again to complain of the pruns and of irregularly remittent fever. This time there was a widely spread edema of the right forearm while a circumscribed mass on the radial side of the limb on the middle third could be felt. He was then treated with rest, heat, injections of iodine and mercury without success. In January 1912 the patient entered my division.

On the middle third of the right forearm a mass could be felt which bulged on the anterior and posterior surfaces of the limb while the medial and external faces were almost normal. The mass was firmly adherent to the middle part of the shaft of the radius and it was more prominent forward than behind a little rather externally. The consistency varied in places it was bony hard in others elastic or fibrous. The mass was not pulsating, pressure was not painful. There was a slight limitation of pronation and supination. No palpable lymph glands were felt at the epitrochlea or in the axilla. The thorax was quite normal. Radiograms revealed a rarefaction, swelling and an irregular structure of the middle part of the radius shaft and the cortex with the medullary canal were caught in the process (Fig. 10). Below a fairly long piece of the shaft was uninjured but above the process reached a level as high as the tubercle of the biceps muscle. Fluoroscopic examination of the thorax was negative. The rest of the history of the case is irrelevant.

Under the diagnosis of sarcoma of the right radius shaft I resected on February 1911 the invaded segment of bone and put in its place a graft from the right fibular shaft. Uneventful recovery fol-

lowed. I shall speak afterward of the microscopic and macroscopic examination of the tumor.

I think it interesting to remember that the patient did well for nearly 2 years. During this period the function of the right upper limb was good. A fibular graft had been substituted for the radial shaft, the lower right limb having been deprived entirely of its fibular shaft. The graft was perfectly soldered with both stumps of the resected radius and had gradually changed to what looked in the radiograms like a normal radius (Figs. 11 and 13).

The patient came to me again in 1914. He had developed a local recurrence of the tumor on the inferior radial stump. In February 1914 I resected the whole inferior end of the radius disarticulating it from the carpal bones. I grafted in its place a splint from the other fibula (left) which I implanted into the scaphoid at one end and the other Z shaped end I fastened above with a Luttt brand. The immediate result was good although not so good as after the first operation. However it lasted but a short time because the patient soon developed another local recurrence followed by metastases in the occipital and parietal bones and in the lower dorsal vertebrae. They grew rather fast especially the cranial metastases and became the source of sharp pains. Pulmonary symptoms occurred followed by rapid emaciation and death August 25 1916 4½ years after the first operation.

In all this long time the thyroid gland revealed no change in size, nothing abnormal was to be noted in the neck or in the neighboring regions, there were no symptoms to call attention to the gland.



Fig 14 Gross specimen



Fig 15 Longitudinal section of specimen

The specimen removed at the first operation included 11.5 centimeters of the radial shaft, above and below, the bone and periosteum which covers it for 1.5 centimeters looked quite normal. The intervening part between these two was composed of a spindle shaped irregularly laterally flattened mass, it had a major anteroposterior diameter of 7.0 centimeters and a lesser laterolateral one of 3.5 centimeters. The two lateral edges of the radius appeared nearly normal, while the anterior and posterior surfaces were each covered with a mass the shape of half a spindle (Fig 14).

Each one of these two masses had a lumpy surface the various lumps were separated by grooves and had different color and consistency. Some were very dark, nearly black, others reddish, pink whitish, while some were rather soft, others were hard or elastic. There were no places where egg shell cracking was to be felt. Near both ends of the mass one could feel deeply a roughness as of bony particles.

The tumor was sawed longitudinally in an anteroposterior division and in its axis the bone tissue of the radius could be recognized (Figs 15).

At both free ends the radius presented a broad medullary cavity limited by a thin but ivory like cortex, but while on the anterior surface of the bone this could be followed from one end to the other, on the posterior surface it lost itself in the tumor. Along the whole neoplastic mass there was no medullary cavity, there were instead many strong bony strands with a prevailing longitudinal course, uniting with each other.

All along the radius in the sawed piece the neoplastic mass looked like two caps put on the bone and firmly adherent to it. Toward the external side the mass was encapsulated by a connective tissue which in some places was not well defined from the surrounding tissues. Connective tissue septa radiated obliquely above and below from the middle part of the external surface of the bone to the internal surface of the capsule. They corresponded to the aforementioned grooves on the surface of the tumor. In this way irregular areas of varied sizes were formed filled with a parenchymatous tissue, in some places reddish and soft, in others brown and firmer. This neatly lobulated structure was more evident in the anterior half. The posterior one was more irregular and toward the bone was formed by plenty of bony trabeculae between which the neoplastic mass reached the center of the bone and filled the medullary cavity.

Specimens for microscopical examination were taken from several places. When decalcified and differently stained they revealed different structures in the reddish and in the brown parts.

In the reddish part and in the smaller nodules (Fig 16) very small cavities whose walls were embedded in the connective tissue were lined by a single layer of cubical cells. There were places where the connective tissue bulged like a bud inside the cavity. It divided itself into many branches all coated by the aforementioned cubical cells (Fig 17). These elements were all alike, small, with an ovoid, big, deeply stained nucleus having a single





Fig 16



Fig 17

nucleolus. Their cytoplasm was scanty, apparently homogeneous, well stainable. The divisions between the cellular bodies were not very clear. They were generally disposed in one layer, very seldom in two or three. The connective tissue and the papillary structures looked young with a plentiful supply of blood vessels.

In other points, especially at the outer border of the neoplastic masses, there were still simpler structures which, however, were of the same general character as those already described.

Also in the larger nodules we found round cavities lined by the epithelial layer. They had papillary proliferations with a blood vessel in the axis coming off the wall. In the microscopic field they appeared to be composed of a transversely sectioned blood vessel. Around it there was a halo of young connective tissue coated by epithelial elements (Fig 18). It could be recognized because the larger nodules were composed of several minor ones blended together and indeed one could still recognize connective tissue septa with small arteries and veins running in the depth of the nodule (Fig 19).



Fig 18

The big brown nodules presented a different aspect. We found in them among a rich connective stroma, round or ovoid cavities lined by big cubic or columnar epithelial cells and filled with a spinous edged substance without structure (Fig 20). These cavities had a very variable shape and size, in the small ones the lining cells were rather flattened. In the bigger ones they were frankly cubic or columnar. They had well defined borders, uniformly granulous cytoplasm with a condensed superior edge, big rather basal round shaped nucleus, a well evident membrane, a scanty chromatic network, and one or two big nucleoli (Fig 21).

There were also other elements among these which were narrower, with a more deeply stained cytoplasm and smaller nucleus. Mitotic figures were also present.

The homogeneous substance which filled the cavities could be stained yellow with van Gieson's dye, orange with Mallory's, bright red with Traub's (Figs 22 and 23).

For other, although interesting histological details in connection with the stroma, the relations between the stroma and the follicles, the bone marrow in place of which neoplastic tissue was to be found, and the relations of this tissue with the soft surrounding parts, I refer the reader to Zappelloni's paper.

From this brief description of the preparations and from the figures it clearly appears that we have to deal with a thyroid tissue, especially in the brown areas of the tumor, while in the reddish areas the papilliferous type is evident. And at least after the studies of Langhans and Getzow's work, we can believe that we are dealing with proliferations of the elements of the thyroglossal duct and of the lower endodermic branchial pouch.

The tumor can then be defined as vesicular and microcystic papilliferous adenocarcinoma of the thyroid type.

There is scarcely any doubt that the tumors in question were skeletal thyroid tumors (upper end of the humerus in the first case,

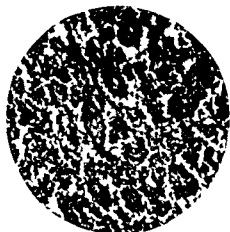


Fig 19



Fig 20

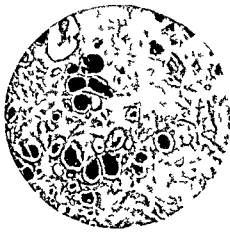


Fig 21

radius shaft in the second) with progressive course, local recurrences, and with multiple metastases in the second case. These characteristics confirmed the diagnosis of malignancy.

I think that there can be no doubt that in the first case the neoplastic tissue was not only clearly thyroid, but also parathyroid in type. Although the description of the microscopic examination has been shortened, together with the pictures it is quite clear.

I consider these 2 cases so important and have reported them because the thyroid gland did not show even the slightest change or enlargement before the onset of the skeletal growth, during its development, nor after the operations, which in both cases had to be repeated because of recurrences. Nothing which could possibly represent the primary site of an eventual tumor whence the metastases might have proceeded could be detected in the regions of the neck, of the tongue, or in the mediastinum where aberrant thyroid glands are usually found.

In the first case, a man 51 years old, D'Urso operated with the diagnosis of sarcoma of the head of the humerus and thought afterward that the tumor was an endothelioma, now it can be objected that he did not examine with great care the thyroid gland and its neighboring regions. But after 7 years when I performed the interscapulothoracic disarticulation I was not able to find anything even suspicious, and after another year when I saw the patient he was still free from recurrences and the structures of the neck were quite

normal. As I have said, I have not been able to follow this patient up and I cannot give further information about the course of the disease. But during the 8½ years after the apparent onset of the lesion and the 8 years after the first removal of the thyroid bone tumor, the patient underwent many examinations and it can be stated that in this long time no changes could be found in the thyroid gland.

I think the second case also typical. Microscopic examinations after the first operation proved the thyroid nature of the radial growth and although careful examinations were made we could detect no changes at all in the thyroid gland nor the presence of other structures which could be interpreted as normal or enlarged accessory thyroid glands.

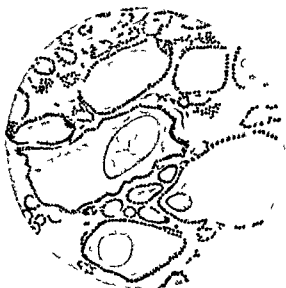


Fig 22



Fig. 3



Fig. 4

Zapelloni in his paper (1913) emphasized the perfect integrity of the thyroid gland 2½ years after the onset of the bone lesion and 14 months after the operation. And the already reported further course of this case with its second operation for local recurrence and its metastases in the cranial bones and in the vertebral column which I followed to the death of the young man allows me to state that during all this time (6 years after the apparent onset of the radial lesion and 4½ years after the first operation) I saw nothing abnormal even with the most careful and minute examination in the thyroid body nor in the neck and neighboring regions.

I do not think it possible that even a small primary neoplasm which ought to be anterior to osseous localizations could be present for 8½ years in one case and 6 years in another without revealing itself.

And if this statement cannot as it looks to me be denied it is not a question of benign metastasizing goiter. Therefore Simpson seems to be correct in his opinion that it does not exist or is a very doubtful entity because of the great clinical and microscopic similarity between simple goiters and malignant thyroid tumors. But we are compelled to admit that osseous tumors of thyroid or parathyroid type can be found without any primary lesion of the normal or accessory thyroid gland.

In these cases of seemingly perfect integrity of the thyroid gland as I have already said in speaking about the goiters and the benign

tumors we cannot offer any other explanation than one of the following two:

1. These growths may proceed from aberrant embryonic germs. This explanation is the one expressed by Zapelloni in the discussion of the 2 cases and by Verga (-5) in a case of similar growths of suprarenal type.

Normal cellular elements may be conveyed to distant places and in their new site for unknown reasons can grow in an atypical way. This possibility was observed by Gaylord in fishes by Riedel and Oderfeld and Steinhaus in thyroid tissue and by Pick (15) and Munis (16) in suprarenal tissue.

I have already pointed out that it is not easy to explain with the first hypothesis the metastases far from the neck and from the complex mesobranchial structures which though not frequently have been observed in some cases.

The findings of my first case apparently disprove the second hypothesis; indeed, the simultaneous presence of thyroid and parathyroid tissue if it can be explained as an embryonic aberration of neighboring tissue growth during the complex work of development can not be thought of as an embolism of normal elements of different tissues at the same site. This looks to me like a very strong objection. I should rather incline toward the former explanation but the question is a very difficult one and I think can not be solved by us engaged more on the clinical side of it. I leave it to be solved by the especially competent pathologists.

I have reported my cases because of the thoroughness of the study and the long time they have been followed up. I wish only to add in conclusion that the presence of thyroid and parathyroid tissue in the tumor of my first case seems especially important because not only is it very improbable that normal cells of different although neighboring organs were conveyed to a distant site but above all the presence of even a small, not easily detectable tumor seemed unlikely. Indeed we would have to believe, according to this hypothesis, that this small neoplastic primary nodule was not only composed of two different tissues both with a neoplastic value, but that both at the same time had metastasized to the same site.

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## MULTIPLE CARTILAGINOUS EXOSTOSES—DIAPHYSEAL ACLASIS

By PHILIP LEWIN M.D. F.A.C.S. CHICAGO

Associate Professor of Orthopedic Surgery Northwestern University Medical School Attending Orthopedic Surgeon St. Luke's Hospital Cook County

THE writer wishes to record 6 cases of multiple cartilaginous exostoses and to call attention to the similarity between that condition and chondrogenesis imperfecta or achondroplasia. There are over 600 cases on record. The first case reported in America was by Gibney in 1875. Sir James Paget described the condition in 1853. It is stated that it was first recognized by Hawkins in 1839 and the first complete study was made by Ollier in 1899.

In the present series this condition has been noted at as early an age as 5 months as in Case 1. Children have been born with exostoses present. Males predominate in the ratio of about 3 to 1. This ratio is probably due to the increased risk of trauma in the male. Heredity is definitely established. The condition is rare in the colored race. Retarded puberty has been noted repeatedly and this fact together with the frequent disappearance of the exostoses at puberty have been offered as proof of a glandular etiology. Keith believes that the condition of multiple cartilaginous exostoses is related to achondroplasia and may be due to a disturbance of function of the glands of internal secretion most likely of the thyroid.

Virchow believed the exostoses develop from splintering off of the growing cartilage in intra uterine or extra uterine life. Voorhoeve believes there is a transitional stage between cartilaginous dysplasia and the condensing bone affection known as Albers Schoenberg's *Marmor Knochen*. Renfrew White recently described two cases of multiple exostoses and of chondrodystrophia fetalis and remarked on the similarity in clinical appearance as contrasted with the absolutely dissimilar nature of the defect in bone development.

Wladimir Ulrich states that cartilaginous exostoses develop as an achondroplasia are developmental, and have their origin in the organs which influence bone growth namely the glands of internal secretion. He states

that the true cause is unknown but probably lies in a series of disturbances which may appear in one case as rickets in another as multiple exostoses and at a more advanced age as arthritis deformans. The reader is advised to read the excellent monograph by Rischbieth and Barrington.

In an admirable paper by Sir Arthur Keith a very suggestive new theory of pathogenesis is presented. This writer states that the condition of exostoses should be taken out of the category of bone tumors and placed among the disorders of growth and because it is a disturbance of the modeling or pruning of the diaphyses he proposes the name of "diaphyseal aclasis."

He reviews some work of Hunter's stating One of John Hunter's more important discoveries was his realization that the shafts of bones grew in length by a double process, there was first the deposition of new bone in the cartilaginous growth disc at the ends of the shaft a process clearly recognized before Hunter's time there was in the second place a modelling process by which the new bone thus laid down was pruned reformed and incorporated as an intrinsic architectural part of the cylindrical shaft. Hunter clearly recognized that these two processes were independent operations. If Hunter's teaching is true then we ought to find disorders of growth in which deposition of new bone goes on while the second or remodelling process is retarded or even completely arrested. A survey of the skiagraphs of the first case of multiple exostoses that came my way showed me that in this disorder the deposition process goes on but the modelling process is retarded and aberrant. In multiple exostoses which is a disorder of youth and of adolescence, then, the modelling process is profoundly retarded, in some instances almost arrested. The bony excrescences or tumors which serve as diagnostic marks for the clinical recognition of the condition, are merely secondary results

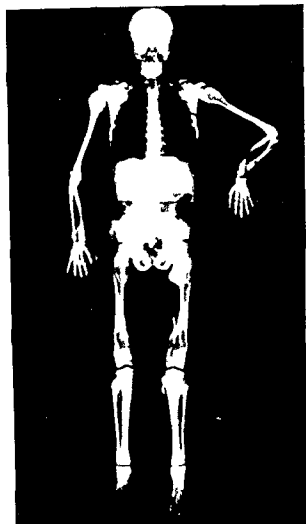


Fig 1 Composite roentgenogram of Case 1

of the primary disorder of growth for which I propose the name of 'diaphyseal aclasis'." Keith states that about half the subjects of this condition gave a history of one or more



Fig 3 Left forearm of Case 1 Note disturbed relations of elbow joint structures

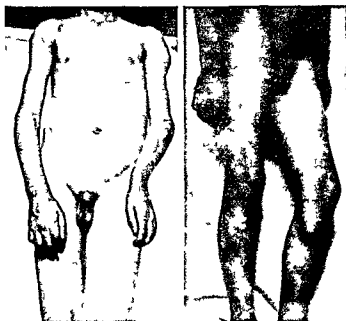


Fig 2 Case 1 showing bowing of left forearm and exostosis below left knee

relatives similarly affected and that the disorder is Mendelian in its incidence

The disturbance is confined to those elements of the skeleton in which bone laid down within cartilage comes to be covered by periosteal bone, as in the shafts of the long bones. Hence this disorder of growth occurs in the growing ends of the shafts of long bones where a core of bone formed within cartilage comes to be encased in a sheath of bone formed beneath periosteum. Where growth is most marked and most prolonged, as at the distal and proximal ends of the femur, tibia, and fibula, at the distal ends of

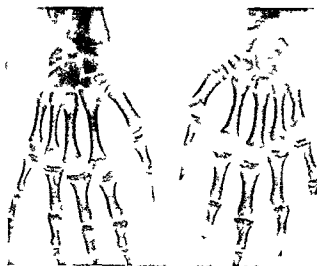


Fig 4 Hands of Case 1



Fig 5 Right shoulder region of Case 1 showing exostoses of scapula

the bones of the forearm and at the proximal ends of the humerus the aclastic condition is most marked. It is also particularly well seen at the growth line along the vertebral border of the scapula and along the cristal border of the ilium. The outer and inner ends of the clavicle being formed from both cartilage and membrane also show an unmodeled formation.

Storey's patient had a brother and 4 maternal uncles who were affected with the



Fig 6 Pelvis and hips of Case 1

same disorder. Percy reported that in a family of 4 generations in which 113 persons were investigated 26 were affected 22 were males and 4 females. Reinecke traced 172 cases in 36 families.

In an attempt to determine the bone changes Keith superimposed the tracings made when a girl of 16 was first observed and those made 10 months later and made accurate observations. He states that all bones formed entirely within cartilage are free from any disorder of growth. The tarsal and carpal bones the epiphyses of all the long bones the vertebral bodies and sternum are formed in aclastic individuals as in normal persons. Likewise are the bones formed in membrane—the bones of the cranial vault and of the face.

The exostoses occur at the epiphyseal ends of the long bones especially the tibia and femur at the knee.

The various types of exostoses are spinous, sessile pedunculated oblique and straight. The associated pathology consists of limitation of joint motion bursitis, periostitis, and fracture with pseudarthrosis. Mosenthin re-



Figs 7 and 8 Anteroposterior and lateral views of knee region of Case 1

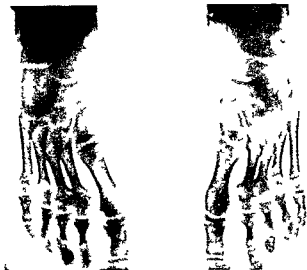


Fig 9 Feet of Case 1

ported a case of aneurysm of the popliteal artery due to irritation of an exostosis. Ochsner and Rothstein reported a case of exostoses within the spinal canal.

The most prominent findings are the exostoses. These are usually painless unless traumatized or subjected to pressure by neighboring structures. During a period of rapid growth they may be tender or sensitive. Swelling is usually easily seen. Deformity due to curvature of bone may be produced especially in the forearm or leg. When two



Fig 10 Lateral view of one foot of Case 1

long bones are parallel and connected by an interosseous membrane, unequal growth in bone will result in deformity. In the forearm there is produced a manus varus or manus valgus depending upon the bone affected. The exostosis may interfere with the function of the muscles, tendons, or joint. Injury to the exostosis may result in bruising, fracture, or hematoma formation. Bursitis may result from trauma to the exostosis. Associated symptoms may be of a glandular nature such as the delayed sex growth noted in Case 1. Many of these patients are below the normal in muscle power.

The diagnosis is based upon the history, the findings, the exostoses, and the roentgenograms. The differential diagnosis between osteitis fibrosa cystica, cysts of the long bones, and other bone tumors should be made easily.

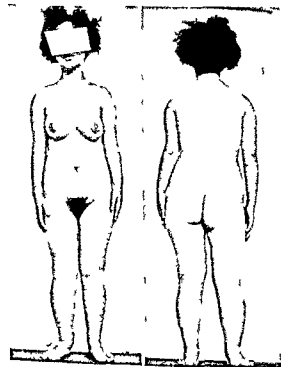


Fig 11 Case 2 similar to achondroplasia

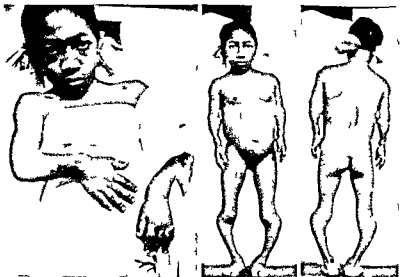


Fig 12 Case 7, hypertrophic chondrodystrophy





Fig 5 Right shoulder region of Case 1 showing exostosis of scapula

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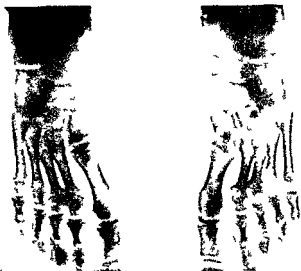


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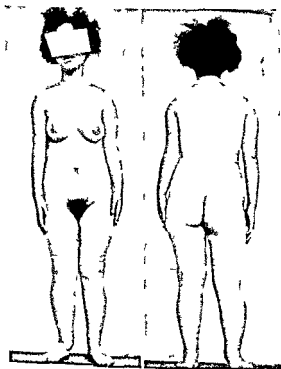


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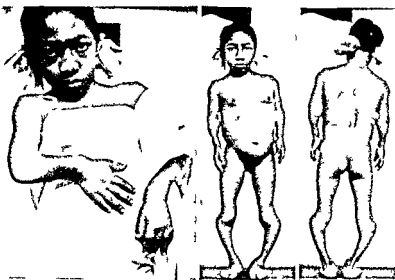


Fig 12 Case 7 hypertrophic chondrodystrophy



Fig. 13 True achondroplasia



Fig. 15 True achondroplasia



Fig. 16 Pseudo achondroplasia



Fig. 14 Roentgenogram of Figure 13 illustrating epiphyseal changes in achondroplasia

The prognosis concerns chiefly the question of malignancy from chronic irritation. A malignant enchondroma might result.

As in Case 1, some of the exostoses might disappear. In this case the original growth has entirely disappeared.

The non surgical treatment consists of protection of the exostoses from injury which might result in periosteitis or fracture. The surgical removal of the exostoses is indicated under several conditions that is excessive size, interference with the function of a joint, a muscle or a tendon pressure symptoms, sensitiveness of the exostoses and repeated trauma which might result in malignant de-

generation or fracture. Removal of the cartilaginous cap must be complete. If correction of the deformity is indicated as in Case 1, osteotomy of the forearm is advisable.

#### CASE REPORTS

**CASE 1.** E. H. male 12 years old born in Leeds South Dakota son of a physician was referred by Dr. Vander Mark. He is the second of 3 children. His mother was in labor 3 hours. He was apparently a normal baby and was breast fed for 5 months when a complementary feeding was used. He had a tooth at 6½ months and walked at 1 year. There is no family history of similar trouble.

The first symptom at the age of 5 months was a small mass on the left forearm. This mass has since disappeared. At various intervals new exostoses appeared on practically all of the large long bones, the only one causing trouble being the one above the left wrist which has produced a curvature of the forearm. The masses about 50 in number caused no pain. The only other point of possible interest in the history is that the boy likes to chew gristle.

**CASE 2.** M. D. a girl 1 year of age was referred by Dr. D. H. Levinthal. The case is one of mild though typical achondroplasia.

**CASE 3.** A. B. a soldier at Camp Grant Illinois was referred by Dr. Lester Palmer.

**CASE 4.** M. S. was the wife of a U. S. colonel and patient of Drs. A. R. Elhott, John Ridlon, and J. L. Porter.

**CASE 5.** J. S. was the son of the patient in Case 4, and a patient of Dr. John Ridlon.

CASE 6 C D a colored girl of 14 years, seen at the St Luke's Hospital outpatient department, was probably a case of true hypertrophic chondrodys trophy

#### SUMMARY AND CONCLUSIONS

Hereditary deforming chondrodysplasia or multiple cartilaginous exostoses, to which condition Keith has given the name of "diaphyseal aclasis" or failure of the diaphysis to shape itself normally, is manifested by multiple painless exostoses occurring chiefly at the epiphyseal ends of the long bones especially in the region of the knee joint. They may be found at birth but more commonly during young childhood. Occasionally they disappear spontaneously. They are benign and only infrequently require surgical treatment. The writer believes that multiple cartilaginous exostoses and achondroplasia have many points in common and possibly a related etiology.

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## OSTEITIS DEFORMANS

By WILLARD VAN HAZEL M.D. AND EDMUND ANDREWS M.D. F.A.C.S. CHICAGO

From the Department of Surgery, University of Illinois

PAGET'S disease of bone was first described in 1877 by the one whose name it bears. Osteitis deformans was the descriptive name used by the author in his original report of 5 cases which still remains as the greater part of the sum total of our knowledge of this affection. Later he added 7 cases to this and by 1889 had seen 23 cases.

## FREQUENCY

Since 1889 cases have been reported from time to time. Lewin in 1925 collecting 251 from the literature which suggests that it may rightfully be termed a rare disease of bones. Undoubtedly many cases occur which are unrecognized. In the large hospitals we find Hurwitz recounting 3 cases in 30,000 medical admissions to the Johns Hopkins Hospital, Carman and Carrick 15 in 237,000 admissions to the Mayo Clinic over a period of 6 years. Da Costa, Funk, and others 13 in 38,000 admissions to Jefferson Hospital. Cutler 7 cases in 285,000 out-patient admissions to the Massachusetts General Hospital in 12 years.

The most frequent site of the malady is in the tibia, femora, the vault of the skull, pelvis, spine and clavicles. The ribs, ulna, radius, jaw and metacarpals have been affected in some instances. When the lesions occur in the long bones they are more often symmetrical and this generalized manifestation is by all odds the more common.

In 1883 Bowlby first called attention to one bone involvement. A cab man who had been injured came to autopsy with the findings of osteitis deformans in the right femur alone, a condition which was known to have existed for 10 years. The course of the disease is prolonged, and some may offer the criticism that the one bone type is an early stage. However, in some well authenticated cases years have passed with no changes elsewhere. Hurwitz and Carr in 1914 reported 7 cases and added another of one bone involvement. Newton last year collected 5 more to which he added 3. Among the latter Romer had 3 patients, all

with a history of trauma while Newton could find no trauma playing a possible part in his 3 cases. Trauma however has been elicited in the history more often in the one bone type. In one of Newton's cases the disease was stationary for 3 years. Cone observed a patient for 10 years with the disease localized in the right femur and Ely described the bone from a patient whose right femur alone had been affected for 30 years.

## ETIOLOGY

The suggestion made in the earlier writings that lues is a possible cause has not been sustained and in all likelihood lues bears no relationship to the condition. Da Costa states that four fifths of the cases show a negative Wassermann and a positive Wassermann has not been seen in uncomplicated cases. He does not agree with some that it is a latent manifestation of inherited syphilis.

Trauma to the part involved is noted quite frequently particularly in the one bone manifestation of the disease and is believed by some to be a factor. The history of trauma, however, is seen to occur in some shortly before the onset of symptoms while in others years have elapsed. In our patient slight injury occurred 1 month prior to bowing. It seems quite doubtful whether trauma is to be considered seriously as a causative factor. Leri reports trauma 8 months before involvement of the humerus. Perhaps injury calls attention to the disease that is already present, when years have elapsed it is probably simply coincidental.

The trophic theory cited by Prince and others, gives a neurological basis to the disease, as seen in tabes and syringomyelia. Prince reports nerve or cord changes in 6 out of 10 cases. Packard with others maintains that no cord or nerve changes occur and quotes a similar view by Von Recklinghausen.

In the search for the cause of the disease bacteriology has not been overlooked. Da Costa credits Italian investigators, Archangeli,



Fig 1 This area shows considerable bone destruction the giant cells or osteoclasts are numerous and are seen in some instances to give an eaten out appearance to the adjacent bone The osteoid lasts give the suggestion of occupying a niche

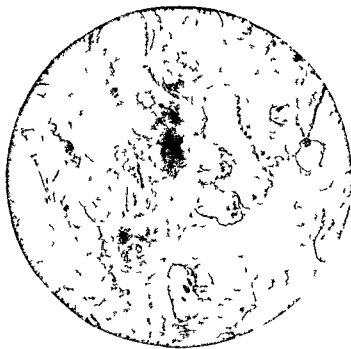


Fig 2 This section shows what might be termed a stage of healing The osteoid tissue filling the marrow spaces is a vascular fibrous tissue Some spaces are lined by osteoblasts while others are crowded with them Giant cells are less numerous than in Figure 1

Fiocca, and Morpurgo, with the claim that an organism has been cultured from pagetic bone, the nature of which was a diplococcus. A vaccine made from the recovered organism, was reported to be of value in the treatment. The work on this phase has not been extensive and Ellis was unable to obtain any organism in 2 cases from which bone had been removed from the tibia.

The assumption of a disturbed metabolism has given rise to considerable work. Believing a continued toxic basis due to disordered metabolism may give rise to the bone changes has led to investigation in this field. The parathyroids have been reported to be the seat of adenomata in the disease. Collip and his workers have shown by extensive work the association of these organs with the calcium balance. The nature of the affection likewise suggests that this phase is worthy of careful investigation. Da Costa sums up Hawk's work by stating "The metabolic changes of Paget's disease are of interest and probably of importance. They indicate a pronounced retention of calcium, magnesium and phosphorus, and a large elimination of sulphur. It may be that during the formation of

new bone the osteoid tissue produces a highly sulphurized organic matrix which is gradually calcified by the deposition of calcium, magnesium, and phosphorus. In the course of calcification a certain amount of this sulphur must be replaced by the other elements. Hence, the retention of calcium, magnesium, and phosphorus, and the increased elimination of sulphur. This state of affairs is to a considerable extent the reverse of what we find in osteomalacia."

Knaggs seeks to correlate the disease with osteitis fibrosa and osteomalacia. In so doing he assumes a continuous toxic basis which acts in one with a peculiar susceptibility to bone disease. The picture which presents itself is influenced by the vitality of the patient. Osteitis deformans occurs when the vitality is great enough to resist the disease process until old age, when the reaction to the disease is only fair, osteitis fibrosa results, when no reaction occurs, osteomalacia. He assumes, of course, first a toxic basis, which is not proved, and further a peculiar susceptibility in certain individuals. The pathology he grants is different and the work of Hawk shows unlike metabolic variations.

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PAGE'S disease of bone was first described in 1877 by the one whose name it bears. Osteitis deformans was the descriptive name used by the author in his original report of 5 cases which still remains as the greater part of the sum total of our knowledge of this affection. Later he added 7 cases to this and by 1889 had seen 3 cases

## FREQUENCY

Since 1859 cases have been reported from time to time. Lewin in 1915 collecting 251 from the literature which suggests that it may rightfully be termed a rare disease of bones. Undoubtedly many cases occur which are unrecognized. In the large hospitals we find Hurwitz recounting 3 cases in 30,000 medical admissions to the Johns Hopkins Hospital. Curman and Carrick 15 in 237,000 admissions to the Mayo Clinic over a period of 63 years. Dr. Costa, Funk and others 13 in 38,000 admissions to Jefferson Hospital. Cutler 7 cases in 285,000 out-patient admissions to the Massachusetts General Hospital in 12 years.

The most frequent site of the malady is in the tibia, femur, the vault of the skull, pelvis, spine, and clavicles. The ribs, ulna, radius, jaw, and metacarpals have been affected in some instances. When the lesions occur in the long bones they are more often symmetrical and this generalized manifestation is by all odds the more common.

In 1883 Bowlby first called attention to one bone involvement. A cabman who had been injured came to autopsy with the findings of osteitis deformans in the right femur alone, a condition which was known to have existed for 10 years. The course of the disease is prolonged, and some may offer the criticism that the one bone type is an early stage. However, in some well authenticated cases years have passed with no changes elsewhere. Hurwitz and Carr in 1914 reported 7 cases and added another of one bone involvement. Newton last year collected 5 more to which he added 3. Among the latter, Romer had 3 patients, all

with a history of trauma while Newton could find no trauma playing a possible part in his 3 cases. Trauma however has been elicited in the history more often in the one bone type. In one of Newton's cases the disease was stationary for 3 years. Cone observed a patient for 10 years with the disease localized in the right femur and Ely described the bone from a patient whose right femur alone had been affected for 30 years.

## ETIOLOGY

The suggestion made in the earlier writings that lues is a possible cause has not been sustained and in all likelihood lues bears no relationship to the condition. Da Costa states that four fifths of the cases show a negative Wassermann and a positive Wassermann has not been seen in uncomplicated cases. He does not agree with some that it is a latent manifestation of inherited syphilis.

Trauma to the part involved is noted quite frequently particularly in the one bone manifestation of the disease and is believed by some to be a factor. The history of trauma however is seen to occur in some shortly before the onset of symptoms while in others years have elapsed. In our patient slight injury occurred 1 month prior to bowing. It seems quite doubtful whether trauma is to be considered seriously as a causative factor. Leri reports trauma 8 months before involvement of the humerus. Perhaps injury calls attention to the disease that is already present when years have elapsed it is probably simply coincidental.

The trophic theory cited by Prince and others gives a neurological basis to the disease as seen in tabes and syringomyelia. Prince reports nerve or cord changes in 6 out of 10 cases. Pickard with others maintains that no cord or nerve changes occur and quotes a similar view by Von Recklinghausen.

In the search for the cause of the disease bacteriology has not been overlooked. Dr. Costa credits Italian investigators Archangeli,



Fig 1 This area shows considerable bone destruction the giant cells or osteoclasts are numerous and are seen in some instances to give an eaten out appearance to the adjacent bone The osteo lasts give the suggestion of occupying a niche



Fig This section shows what might be termed a stage of healing The osteoid tissue filling the marrow spaces is a vascular fibrous tissue Some spaces are lined by osteoblasts while others are crowded with them Giant cells are less numerous than in Figure 1

Fiocca, and Morpurgo, with the claim that an organism has been cultured from pagetic bone, the nature of which was a diplococcus. A vaccine made from the recovered organism, was reported to be of value in the treatment. The work on this phase has not been extensive and Ellis was unable to obtain any organism in 2 cases from which bone had been removed from the tibia.

The assumption of a disturbed metabolism has given rise to considerable work. Believing a continued toxic basis due to disordered metabolism may give rise to the bone changes has led to investigation in this field. The parathyroids have been reported to be the seat of adenomata in the disease. Collip and his workers have shown by extensive work the association of these organs with the calcium balance. The nature of the affection likewise suggests that this phase is worthy of careful investigation. Dr Costa sums up Hawk's work by stating "The metabolic changes of Paget's disease are of interest and probably of importance. They indicate a pronounced retention of calcium, magnesium and phosphorus, and a large elimination of sulphur. It may be that during the formation of

new bone the osteoid tissue produces a highly sulphurized organic matrix which is gradually calcified by the deposition of calcium, magnesium, and phosphorus. In the course of calcification a certain amount of this sulphur must be replaced by the other elements. Hence, the retention of calcium, magnesium, and phosphorus, and the increased elimination of sulphur. This state of affairs is to a considerable extent the reverse of what we find in osteomalacia."

Knaggs seeks to correlate the disease with osteitis fibrosa and osteomalacia. In so doing he assumes a continuous toxic basis which acts in one with a peculiar susceptibility to bone disease. The picture which presents itself is influenced by the vitality of the patient. Osteitis deformans occurs when the vitality is great enough to resist the disease process until old age, when the reaction to the disease is only fair, osteitis fibrosa results, when no reaction occurs, osteomalacia. He assumes, of course, first a toxic basis, which is not proved, and further a peculiar susceptibility in certain individuals. The pathology he grants is different and the work of Hawk shows unlike metabolic variations.



The roentgenological description of the disease has been carefully set forth by Carman and Carrick who state "The whole architecture of the bone is altered the essential features being porosis and the formation of new bone with hyperostoses one or the other process predominating in different parts. In later stages new bone tends to become sclerosed and takes on a dense white appearance with a much decreased permeability to the X rays. The structure of the bone appears to be almost entirely removed and laid down afresh on a different plan and in a larger mould.

"The long bones lose their clear cut outline they become curved and the thickening appears to be greatest on the convex surfaces. In some places subperiosteal thickening is seen while in others decalcification beneath the periosteum has progressed irregularly. The small cysts frequently mentioned in the literature were observed but once in our cases.

"The spine and pelvis when affected take on a dense white appearance or the picture may be that of porosis with fine and coarse trabeculation or there may be a combination of the two. The bodies of the lumbar vertebrae are flattened and widened compared with the normal. The joints are not involved the process extends throughout the epiphyses, but there is no noticeable irregularity of the joint surfaces. There is no approximation of the articular surfaces that is suggestive of atrophy of the cartilages.

The same authors state that a preliminary report of bone metastases was made in 4 of their 15 cases. This occurs particularly when attention is directed first to the pelvis or spine. Not until the long bones and skull are rayed is the true diagnosis made. In 1 of the 4 cases a diagnosis of osteitis deformans was made only after repeated examinations at intervals of a year however, the consultant had leaned toward this affection rather than bone metastases. The changes in the skull increased thickness of the outer and inner table irregularity and porosity are most significant in a suspected case.

#### PATHOLOGY

The process of bone destruction as well as new bone formation is seen microscopically.

Coarse trabeculae of bone form the greater part of the picture. These trabeculae have no plan and run irregularly interspersed by osteoid tissue. Calcification varies in density, in only a few places being dense. This probably accounts for the occasional hardness noted upon removing sections which for the most part cut with surprising ease.

Many giant cells are observed. Figures 1 and 2 show them to be more abundant in certain areas. An eaten out appearance of the adjacent bone obtains the osteoclasts giving the suggestion of occupying a niche.

The marrow spaces are filled with osteoid tissue consisting for the great part of a vascular fibrous tissue. Osteoblasts likewise are numerous in some instances lining by a single layer the marrow space or comprising the whole of the marrow cavity. Some round cell infiltration occurs with diffuse or grouped arrangement of cells.

In bone so disorganized naturally the haversian systems are distorted.

The signs and symptoms of the disease are local and general. Pain is a common complaint and this varies in severity as it varies by its absence in some cases. Paget wrote that pain was "widely various in severity and variously described." It may be present for many months or some years before the patient seeks relief or other signs are manifest. Deformity which includes thickening, bowing, shortening of the long bones and spine occurs. The thickening may be great, the anterior tibial surface in our case increasing in width by one third. The bowing is characteristically outward and forward in the femora and tibia. The shortening is not actual but due to the bowing. The skull becomes larger and the vault tends to flatten adding to the decrease in stature caused by bowing of the spine and long bones of the lower extremities and broadening of the pelvis.

Skin changes likewise vary. Among those seen are discoloration such as that reported by Knaggs, pigmentation, glossy smooth skin and local hyperemia. Bowley reports necrosis occurring in a case. The skin changes are seen where the bone is close to the surface as over the anterior tibial surface. Some of these changes at least might be explained on the

basis of vascular changes and undue pressure which is quite apparent

Weakness was the most striking symptom of which our patient complained. She did not correlate her tibial deformity with this weakness which had become so extreme. She stated the effort to raise a fork was too much and added, "this was not sham because there was no need for it." Lewin reports weakness as a complaint in 1 of his cases and Carman and Carrick mention it in 2 of their patients.

Dizziness, deafness, and choroidal changes have all been found in connection with the disease.

Kidney function was impaired in Scully's case but nothing conclusive as to an interrelation was found. Pinney reports eosinophilia and basophilia in 5 cases. Many have reported normal blood findings however.

As for the clinical course of the disease it can be said it is a chronic one. Some are so little inconvenienced that only after years do they seek a physician for relief. Spontaneous fracture has brought several cases to the attention of a physician for the first time. Cone and Bowlby report the passing of 10 years in which one bone only has been involved. Lewin observed the bowing of legs in his patient for 12 years, 1 of Leri's patients had involvement of the tibia at the age of 52, radius at 63 and the other tibia at 80.

The skin changes follow the disease in the bone. Peruet describes thickening of the skin which began as a blush, in one who had bowing of the legs and spine for 16 years. He found the skin condition to be morpheoscleroderma. Knaggs attributes these changes to "impaired nutrition due to the retarding influence of muscular atrophy and diminished activity upon venous return."

Thus in such a chronic affection we find it compatible with life. Weakness or deformity may inconvenience one to a greater or less degree and fracture incapacitate, but even these tend to heal in the diseased bone. Furthermore, the disease may not be progressive and apparently becomes arrested in some for a time at least, when the patient has little or no discomfort.

Until our knowledge of the cause of osteitis deformans is added to, its treatment may con-



Fig 3 The plate shows the right and left tibia though unfortunately from different positions. The coarseness, bowing, and thickening are evident.

tinue to remain unsatisfactory. As the metabolism is being more closely studied, particularly the calcium metabolism, the parathyroid function in the disease, if any, may come to light. Bessler has just shown marked improvement in the well being of his patient on administration of parathyroid extract after the failure of many other forms of treatment.

Thyroid extract and multiple gland extracts have been of no proven value. Spontaneous fractures have responded well in bone showing such marked changes.

Mrs. J., aged 63, came to the dispensary March 2, 1926, complaining of an aching pain in the right leg and hip and extreme weakness.

Three months before she had bumped her leg on a car seat. The lower leg and area over the right buttock showed slight swelling. She remained in bed for a few days and returned to her work of sewing. The incident was forgotten until a month and a half later when she noted a weakness which was becoming greater. The weakness became so extreme that the lifting of a fork was exertion, she stated, in one who had always enjoyed good health.

It was a member of the family who at this time jested she was becoming bow-legged which first attracted her attention to the deformity of the tibia. At the time of admission this had progressed considerably. In the following weeks prior to her entry into the hospital, March 11, 1926, an aching pain in the hip and right leg had been present. Swelling below the knee appeared and this to the feel she

characterized as spongy or chee and also noted that the skin over the tibia had become discolored.

A roaring when suddenly turning the head had been noted. No changes in vision had occurred. The head had not increased in size. The patient limps not being able to touch the heel to the ground on walking. Clinical. The patient was a well nourished individual. The heart and lungs showed no evidence of disease. The breasts and thyroid were negative.

The right tibia was bowed outward and forward. It was noticeably larger than the left. The skin over the anterior tibial surface had a yellow tinge with areas of blue gray discoloration. The skin to the touch was warmer than that of the left and was tense. The right leg showed one inch of shortening. The width of the anterior tibial surface was 6.5 centimeters compared with 4.5 centimeters of its fellow.

The X ray showed marked bowing of the right tibia with increase (Fig. 3) of thickness and coarse trabeculation characteristic of Paget's disease. The left tibia shows no changes. Films made of the head showed some thickening of skull but no characteristic changes of osteitis deformans. The pelvis showed no definite bone changes. There was an irregular calcified area which probably represented a calcareous gland. No bone change could be seen in the femur.

The urine was negative. The blood count was normal.

Non protein nitrogen 40 milligrams per 100 cubic centimeter of blood. Basal metabolic rate was plus 12. Wassermann blood test and Kahn test for lues were negative. The ophthalmologist reported the pupils fields and tactile tension as normal. With dilated pupils no changes were observed in the disks, vessels or fundi.

On March 17, 1926 a section of the tibia was removed for study (Dr. Van Hazel). An incision of the skin over the anterior tibial surface was made and the skin flaps dissected back and elevated. The periosteum thus exposed was seen to be thickened and nodular. The vascularity was increased greatly. By use of the bone saw a section about 10 to 12 centimeters by 1.5 centimeters was removed. The cortex was markedly thickened and cut readily at times due to the softness of the bony structure being spongelike in character while at other times a resistance was met greater than that of normal bone presenting an almost ivory like hardness.

Grossly the section removed showed essentially a coarseness and was more brittle than normal bone. The wound was closed without drainage. Healing took place readily the sutures being removed on the eighth day and with exception of one stitch puncture from which some blood escaped wound healing was complete.

**Pathological report.** The histological study of the removed specimen was made by Dr. Jaffe who reported. Coarse and irregular trabeculae of bone form a very dense network which is interspaced with

fibrillar connective tissue. The trabeculae consist of atypical bone. The lamellae run in various directions and there is no distinct orientation of them. The bone itself is divided into irregular areas by indented lines of more pronounced calcification while the bulk of the bone shows only scanty deposits of calcium salts. The peripheral parts of the trabeculae have a homogenous appearance and stain purple with eosin. The bone is quite cellular the cell being located in wide and irregular cavities. In some places the trabeculae are thin and more diffusely calcified. But also here the wide empty space about the bone cell is striking. There are a few small fragments of bone without structure and cells.

The marrow consists of fibrillar connective tissue in which there are circumscribed areas of round cell infiltration. To the bone are attached numerous polyhedral cells with round nuclei. They usually form regular rows. There are very many giant cells which often are located in a groove of the bone.

Careful studies of metabolism were made in this case and numerous striking deviations from the normal were noted. In many of these deviations I shall attempt to show suggestions of a profound disturbance of the parathyroid secretion.

When the patient entered the hospital the blood calcium was abnormally high 13.03 in spite of the fact that the patient was evidently retaining much calcium. For a period of 10 days she was put on a milk diet which of course is rather rich in calcium and an analysis of all ingested material both milk and water was made daily. All the excreta during this period were saved and at the end of the period it was evident from Table I that the patient had retained 8.549 grams of calcium.

TABLE I—BLOOD CALCIUM

	Total calcium ingested		Total calcium excreted	
	Grams		Grams	
Milk	1	180	Feces	2.497
Water		277	Urine	1.407
Total	12	453		3.904

In view of the high calcium content at the beginning of the series it was quite surprising to note this retention and furthermore a blood calcium estimation made after this period of rest showed that there had been a fall in the blood calcium. The interpretation of these phenomena present extreme difficulties.

It is evident that although there was a retention of calcium in the sum total a greater

amount than normal was vitalized. The urinary calcium, as has been previously shown by Hawk, was higher than normal. Thus, although more was excreted, this was far overbalanced by the fact that an unusual amount was absorbed. The explanation suggests itself that the bone is unable to retain calcium and it therefore passes into the blood and is excreted. This point will be discussed later in relation to the pathological picture.

The lead having been gotten that changes in the permeability of the tissues might be present, this was tested out by the blister method, previously described by Peterson and Miles. A cantharides plaster was applied and the time required for blister is noted, and when the blister did appear the protein content of the blister fluid was tested by refractometer. In this the blistering time was more rapid than in most cases which we noted in several hundred estimations, and the protein content was also nearly the highest of any estimation of which we have yet made, giving evidence of most extreme permeability of the tissues. The protein content of the blister produced early in the course of the patient's stay in the hospital was 88 per cent of that of the blood serum. Later on after prolonged rest in bed when considerable improvement in the bodily strength had taken place this ratio dropped to 71 per cent.

In relation to permeability we also tested the absorption of glucose. On a fasting stomach a meal of 100 grams glucose and lemonade was given and the blood sugar estimations made hourly thereafter.

TABLE II—TEST MADE TO DETERMINE THE ABSORPTION OF GLUCOSE ON MARCH 18, 1926

Time	Blood sugar
9 30	81 3
9 40	100 0 gm glucose in lemonade
9 45	103 0
10 00	159 8
10 15	19 3
10 30	172 4
11 00	99 5
Urine negative for sugar	

TABLE III—MARCH 26, 1926

Time	Blood sugar
8 00	88 0
8 05	150 0 gm glucose in lemonade
9 00	236 0
10 00	110 0
Urine negative for sugar	

The unusual rapid rise, as compared to the normal, is clear and also the rapid fall in blood sugar. In 1 case only 100 grams were given and the blood sugar rose to 192, almost the threshold, and within the space of an hour and a half has fallen practically to normal. In Table III it is very striking that although the blood sugar was caught for the moment at 236 milligrams, far over the threshold it stayed at this level for such a short time that there was no overflow into the urine. The sudden rise is evidently connected with an abnormal permeability of the gastric mucosa and again the sudden fall suggests that its fixation in the liver or conversion into glycogen also takes place abnormally rapidly, and is another evidence of increased permeability.

The action of adrenalin injections was also tested out and they also appeared to be abnormal as shown in Table IV.

TABLE IV—RESULTS OF ADRENALIN INJECTIONS

Time	Pulse	Blood pressure	Blood sugar
9 40	92	160-04	113
9 45	93	162-94	114 3
0.50 cc cm 1-1000 adrenalin			
9 55	94	160-74	
10 00	105	147-76	
10 05	10	134-76	93 4
10 10	108	158-84	
10 15	99	154-84	
10 25	93	154-82	118 3
10 35	99	156-88	
10 40	102	158-86	
10 50	105	154-84	
10 55	105	152-82	
11 00	108	152-84	
11 05	110	154-82	114 3

The elevation of the pulse continues for an abnormally long time. The blood pressure instead of being elevated falls and the blood sugar does the same, both returning to normal at about the end of an hour. In view of what we know of the autonomic and sympathetic nerve balance, the possibility again suggests itself that with the picture of increased permeability the balance lies far on the parasympathetic side. The leucocytes ran consistently below normal at a great many observations, averaging under six thousand, which also fits into this picture. The basal metabolic rate was 12 plus and the calcium potassium ratio was 2.46 at the end of the period of observation. It was further noted on repeated experiments that the administra-

tion of adrenalin hypodermically caused a fall in the blood calcium (Table V)

TABLE V—RESULTS OF HYPODERMIC INJECTIONS OF ADRENALIN

2 00 p m	Blood calcium 8.65
2 05	3 c cm of adrenalin hypodermically
3 00	Blood calcium 8.32

It is probable from the above statement that in this case there is a polyglandular disturbance of internal secretion which in certain respects bears a striking resemblance to that of parathyroid disturbance. One of the most striking phenomena in this clinical picture was the extreme lassitude and weakness of the patient the exact opposite of what occurs in parathyroid tetany. The same is true of the phenomena of increased permeability, the elevation of blood calcium, the calcium potassium ratio, the lassitude and weakness as compared with the removal of the parathyroid. It is well known that a large number of German observers have consistently discovered post mortem parathyroid adenomata in Paget's disease. This finding as can be shown from the following reference is far too constant to be attributed to chance (Maresch). The only other suggestion of this relation which has come to our notice has been the note by Anthony Bassler in a recent contribution.

#### PATHOLOGY

A study of the pathological picture of the bone excised in this case more or less confirms that previously reported. However in the case here reported the material was taken from the early stages of the condition. Paget's disease runs a very long and slow course in the later stages. Considerable repair takes place the bones regain somewhat their normal strength and an examination of the biopsy specimen here cannot but suggest the picture of a regeneration. There is an absorption of calcium. In most areas all the elements of bone are present but calcification has failed to take place. In addition to this there is an attempt on the part of the body to lay down new bone to compensate for the weakness from decalcification. This new bone which is laid down in large amounts is fairly normal in

structure but is subject to the same defects as the old one. That is the calcification is imperfect. In certain areas in both the new and old bone calcification has taken place but when the entire field is studied as a whole the failure either of the deposition or retention of calcium is evident.

#### CONCLUSION

Therefore the authors would suggest that the pathological picture can be explained on the following basis—due to some disorder in metabolism probably a hypersecretion of the parathyroid gland there is an increase in the permeability of the tissues which entails an inability of the osseous structures to retain the calcium. Calcium can pass freely from a bone to the blood vice versa and in consequence very much of it is lost in the urine. These cases all show a positive calcium balance. The pathological picture in the bone is an attempt of the normal bone forming tissue to strengthen the bone and the hypertrophic bone similarly fails to undergo proper calcification. For that reason growth continues producing the syndrome of large, soft, decalcified bones.

NOTE.—Since the preparation of this paper two additional reports on this subject have come to the attention of the authors. Parnera and Castro Freire (Compt rend soc de biol 1589 xcv 1926) have identified changes in the parathyroids in osteitis fibrosa which they consider to be pathognomonic of hyperfunction. Mandl (Zentralbl f Chir 1927 lxx 257) has removed parathyroid tumors in a case of Paget's disease and brought about improvement.

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## MATERNAL OBSTETRICAL SCIATIC PARALYSIS

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A REVIEW of the literature shows that obstetrical sciatic paralysis has received recognition from an increasing number of sources in the past two decades. All told only a small number of cases of this affection have been reported. Because its manifestations are attracting great attention and because I desire to direct our thoughts again to the etiology and treatment I am prompted to record in detail 2 additional cases, each covering a period of many months. Thus far the condition has been impossible to prevent and difficult to control efficiently.

### ETIOLOGY

From a study of the reported cases I am inclined to believe that we are dealing with a pressure paralysis of the sciatic nerves. In all but 3 cases there is undoubted proof of increased intrapelvic pressure due to one or more of the following factors: (1) a disproportion between the size of the pelvis and the fetal head, (2) a prolonged or difficult labor, and (3) instrumentation. The three possible exceptions are described by two observers. Patel<sup>1</sup> reports an undoubted case of obstetrical peroneal paralysis in a woman 6 months pregnant. This need not really be considered an exception, as there may have been in this woman's case, even at so early a stage, an abnormally large amount of intra uterine fluid, with resultant unusual intra abdominal pressure.

Howell has described 2 cases of sciatic paralysis in women who had apparently normal, non instrumental confinements. In

all of the other cases of sciatic paralysis, however, we have two and often all of the above factors combined operating to cause paralysis. It is difficult to understand why it is that we so often see drop foot, which is evidence that there is a more severe involvement of the external peroneal nerve than of the other branches of the sciatic. Several authors have suggested that the explanation for this occurrence lies in the fact that those fibers of the lumbosacral cord destined to form the external peroneal nerve lie posteriorly and in direct contact with the bony wall of the pelvis, and hence are damaged the most.

Thomas, in the *Johns Hopkins Hospital Bulletin* in 1900, explained the condition as follows: "The upper roots of the sacral plexus do not lie on the pyriformis muscle, but against the bony walls of the pelvis, and are thus exposed to pressure during certain difficult labors. The dorsal off-sets of these roots lie against the bone and receive the chief injury. The external popliteal nerve is made up of these dorsal off sets and therefore paralysis is chiefly located in the distribution of this nerve." Some observers believe that the paralysis is due to direct pressure of the fetal head. This may be true at times, but such pressure cannot be the real cause in most of the cases, because the symptoms are so generally bilateral. It is unfortunate that we have so little information in regard to the exact position of the presenting head in relation to the nerve cords. Such information might shed considerable light on the effect of different vertex positions on intrapelvic nerves. I believe that as a result of one or more of the

<sup>1</sup> Patel, Lyon méd 1905

<sup>2</sup> Howell C M H St. Bartholomew's Hospital Reports xlv p 43

pathological factors outlined above, an abnormal increase in the intrapelvic pressure causes a bilateral sciatic pressure neuritis and paralysis. The fact that the pressure is not of the same intensity on all the nerve bundles accounts for the peculiar and irregular distribution of the motor and sensory symptoms.

#### SYMPTOMS

There is always a bilateral lesion although the symptoms are more pronounced on one side. The lesion is at or near the promontory, consequently the lower lumbar and upper sacral nerves are involved and through them, the lumbosacral cord and the whole sciatic nerve. Thus there are motor and sensory disturbances. The pain is often very distressing and always annoying and exhausting. It may last for many months but usually abates after several weeks. It tends to disappear long before there is improvement in the paralysis. Numbness and tingling frequently present are the earliest symptoms but diminish soon after the onset. Of the affected muscles the anterior leg group is usually completely paralyzed or nearly so, the result being drop foot which constitutes a conspicuous defect. The other muscles of the leg and those of the thigh and even the buttock have variable degrees of weakness but are paralyzed only exceptionally and then only temporarily.

#### COURSE

The prognosis is extremely uncertain. In some instances there is rapid improvement to a practical cure as in my second case. In others there is a permanent drop foot with disability. There is at present no means of estimating the severity of the lesion nor any way of knowing which is the best therapeutic method to hasten the cure or limit the ultimate defect. The treatment is of necessity entirely symptomatic consisting of measures to relieve pain to maintain muscle tone and to hold the foot at a right angle to the leg by some simple appliance until recovery or improvement ensues. It is encouraging to remember that my first patient who appeared to have a permanent drop foot at the end of nearly 2 years has since recovered sufficient

power in the extensor longus digitorum and peroneus tertius to be able to walk without a limp and without a brace.

The most effective treatment must evidently be prophylactic and lies in the hands of the obstetrician. He must bear in mind the possibility of a pressure neuritis and paralysis of the sciatic nerve resulting from abnormal intrapelvic pressure. It is his duty to avoid severe instrumentation and particularly prolonged labors. He must in addition anticipate and prevent the possible ill effects from abnormal pressure that occurs in cases of disproportion between the pelvis and fetal head. Most obstetricians deny any personal experience with postpartum sciatic paralysis, or Erb's palsy in the newborn feeling that such a condition is a reflection on their skill. It might be well to assume that it is a reflection on their ability and thus to stimulate greater care on the part of those devoting themselves to obstetrical practice.

#### CASE REPORTS

**CASE 1:** Pearl R. 28 years old a primipara had a difficult labor due to an abnormally large fetal head. She went into labor on June 12, 1924. The head of the fetus became engaged in the true pelvis but it was too large to pass through the outlet. The maternal pelvis was of normal size and conformation. This was confirmed by me at a later date by stereoscopic X-ray examination. After a tedious and exhausting labor during which high forceps and axis traction were employed without success a craniotomy was performed and a fetus weighing about 14 pounds was delivered.

When the patient recovered from the anesthesia she complained of severe pain in both legs and feet. On the next day the pain was intense and it is said that she could not move either lower limb. Within a day she recovered motor power in her thighs and knees but had bilateral drop foot. The paralysis of the left foot disappeared within a short time but the right foot drop persisted. A month later an ankle brace with a stop joint was applied. In November 1924 5 months after the delivery she still had pain in both legs and a right drop foot walking with the aid of a brace. There was an atrophy of 1 inch in the right leg complete paralysis of the anterior leg muscles, the peronei and the tibialis posticus and weakness of the flexor longus hallucis.

A neurological examination in November, 1924 by Dr. E. D. Friedman of New York revealed a lesion limited to the legs. His report states: "There is distinct foot and toe drop on the right side with inability to effect dorsiflexion of the right foot."

The ankle jerks are both absent. There is some wasting of the right leg. All forms of sensory changes are present in the distribution of the right peroneal nerve. Milder sensory changes are present along the outer margin of the left foot.

"Electrical tests reveal diminished galvanic and faradic responses in the peroneal and anterior tibial group of muscles on the right. There is also some impairment of faradic response in the posterior tibial groups on both sides.

"I do not believe the findings at present can be attributed to any cord injury. It seems to me that they are best explained by a lesion of the lumbosacral cord in the pelvis. This would mean a bilateral sciatic nerve injury with more marked involvement on the right."

One year later, that is in October, 1925, this patient, having worn the brace continuously and received physiotherapy regularly, had improved decidedly. She had no pain in either leg and she had learned to walk almost without a limp. There was still some numbness in the right leg and complete paralysis of the anterior leg group and peroneal muscles. The tibialis posticus and the flexor longus hallucis were no longer involved. Electrical tests at this time by Dr. Hanson of the Hospital for Crippled showed a complete degeneration reaction of the right external peroneal nerve. Physiotherapy was continued to maintain the muscle tone while we were waiting for a possible recovery from the nerve lesion.

In May, 1926, nearly 2 years after childbirth, there was still complete paralysis of the muscles supplied by the right external peroneal nerve, with complete foot drop. The condition was considered permanent. To correct the foot drop and improve walking, the bone block operation on the back of the ankle devised by Dr. Campbell, of Tennessee, was recommended. The patient refused to have this done.

This patient was recalled for examination on July 2, 1926. I was very much surprised to see her walk without any limp. She stated that she had practically forgotten about her foot trouble because she had no pain and no limp and could walk as much as she pleased. An examination showed that she had recovered some power in the extensor longus digitorum and the peroneus tertius muscles, as a result of which dorsiflexion of 120 degrees was possible, just enough to eliminate the limp. She had also slight power in the peroneal muscles. She has evidently improved in the last few months, which is more than 2 years after the onset of paralysis. There is still complete paralysis of the tibialis anticus and extensor proprius hallucis, but in view of the recent return of motor control further improvement may presumably be expected.

The outstanding features in this case are

1 The patient had a normal and rather capacious pelvis

2 The fetus was abnormally large, disproportion resulting

3 A prolonged and difficult labor necessitated much instrumentation with considerable attendant trauma

4 Sciatica and paralysis of both legs appeared immediately after delivery

5 Gradual improvement was marked by early complete disappearance of the paralysis in the left leg and slowly diminishing paralysis in the right leg

6 The sensory disturbances in both legs completely disappeared

CASE 2 Mrs. R., 23 years old, a primipara, went into labor on June 22, 1925. As there was no progress at the end of 36 hours, high forceps were applied and a dead child weighing  $8\frac{1}{2}$  pounds was delivered. As soon as the patient became conscious she complained of coldness and numbness in the left lower limb which felt as if it were asleep. On the following day she felt somewhat easier, but on the third day she experienced great pain in the left buttock, leg, and foot. The pain was very severe at the time of my first examination, July 10, 1925, about 17 days after delivery. The pain was especially marked over the external aspect of the left leg and foot. She also had some discomfort in the right leg, but this was greatly overshadowed by the intense suffering on the left side. Lying down and sitting were very uncomfortable positions. She was least uncomfortable when squatting. This patient was seen by the physician who called me in consultation 4 days before I saw her. He found only partial dorsiflexion of the foot possible, and immediately applied a plaster of Paris ankle bandage to hold the foot at a right angle to the leg. Consequently I was unable to investigate the condition of the muscles about the ankle at this time. The patient states that she first became aware of the weakness and the drop foot on the third day postpartum.

I saw her again on September 23, 1925. The pain had greatly diminished and she felt better and was able to walk about fairly comfortably. Examination of the muscles of both lower extremities showed no paralysis on the right side, while on the left side the tibialis anticus was paralyzed and all of the thigh and leg muscles were weak. The left thigh was atrophied  $1\frac{1}{4}$  inches, and the left calf  $\frac{3}{4}$  inch. Vaginal examination showed a bilateral contracted pelvis, that is, a narrow elongated male like pelvis. This was recently confirmed by a stereoscopic roentgen ray examination. Consequently though the fetal head was not abnormally large, there was, nevertheless, a marked disproportion between the size of the fetal head and the maternal pelvis.

On January 30, 1926, she presented a very marked improvement. She had no pain in either lower limb, but the numbness in the external aspect of the left leg continued. She walked without a limp. There was no paralysis of the muscles of the left lower limb, although there was some weakness about the



hip and knee and in the anterior leg group of muscles. Dorsal flexion was still limited to 100 degrees. The atrophy of the left thigh had become less pronounced but the left calf was still  $\frac{3}{4}$  inch smaller in circumference than the right. An electrical examination made at the Hospital for Ruptured and Crippled by Dr. Hanson showed an apparently complete regeneration of the left external peroneal nerve.

An examination on July 3, 1926, 13 months after the onset of symptoms showed practically complete recovery. She had full control of the left lower limb, no pain in either leg and walked as much as she pleased without a limp. The only evidences of the previous disturbance were atrophy of the left leg and thigh, a light dulling of sensation on the external aspect of the left leg and on the dorsum of the foot and an absence of the left ankle jerk.

The salient features in this case were

- 1 The patient was a primipara
- 2 The labor was terminated by instrumentation and a great deal of trauma
- 3 The disturbance arose from the fact that though the fetal head was normal the pelvis was contracted and abnormally small
- 4 The symptoms were bilateral but were more marked on the left side
- 5 The early symptoms indicated a pressure on the lumbosacral cord similar to the crutch paralysis in the upper extremity

6 There has been practically complete recovery

#### SUMMARY

Maternal obstetrical sciatic paralysis occurs fortunately, only rarely. It usually follows a severe labor in which decided difference between the size and shape of the pelvis and that of the fetal head is encountered and in which more or less extensive instrumentation has been employed. The paralysis is apparently due to an increase in the intra-pelvic pressure causing trauma to the sciatic nerves. The symptoms usually appear immediately after the delivery but are at times delayed several days. They are bilateral and include motor and sensory changes. Drop foot resulting from involvement of the external peroneal nerve is a conspicuous sign. It may disappear partially or completely, but at times as far as our present information goes, may remain permanently. The treatment is entirely symptomatic, and the prognosis must be guarded, for we have no means of discerning the degree of trauma to the sciatic nerves, nor do we know any curative measure.

# CLINICAL SURGERY.

FROM THE GERMAN UNIVERSITY EYE CLINIC

## OPERATIONS FOR TUMORS OF THE ORBIT<sup>1</sup>

By PROFESSOR DR A. ELSCHNIG, PRAGUE, CZECHOSLOVAKIA  
Director of the German University Eye Clinic

### DIAGNOSIS

THE choice of operation for disease processes in the orbit depends chiefly upon the kind and location of the disease, also upon exact diagnosis. In general, all the non acute inflammatory processes cause a more or less slowly increasing change of position (exophthalmos) and displacement of the eyeball. By the manner and direction of the displacement it is possible to locate the disease process even though it cannot be palpated. The latter is made easy by the observation of all related signs and symptoms. Tumors in the muscle cone or in the region of the optic canal quickly lead to the appearance of higher grades of congestion in the optic nerve (choked disk), tumors in the optic nerve and in the optic canal lead to early high grade disturbance of vision or blindness. Because they grow slowly, benign tumors do not give the appearance of congestion in the lids or conjunctiva, they cause only collateral dilatation of vessels. Because of the anterior location of these tumors, especially those rich in blood vessels (hæmangiomas, sarcomata, and hæmangiomatodes), and of the chronic inflammatory tumors caused by syphilis and tuberculosis, the appearance of congestion, oedema, and hyperæmia of the conjunctiva and lids can be noted relatively early.

In the differential diagnosis of tumors of the orbit, we will first consider diseases of the accessory sinuses (mucocele or chronic empyema), such as bulging of the inner orbital wall caused by mucocele of the frontal sinuses, similar bulging in the ethmoid cells on the median orbital wall, and the much rarer bulging of the lower wall of the orbit due to empyema of the antrum of Highmore. It is necessary to establish the location and extent of the mucocele both by rhinological and roentgenological examination. Such examinations should never be omitted in the diagnosis of diseases of the orbit.

Frequently melanin or melanogen appears in the urine in advanced cases of melanotic tumors and especially when metastases to the liver are present.

In the differential diagnosis, chronic syphilitic periostitis, leukæmic or pseudo leukæmic tumors of the orbit or orbital contents (Hodgkin's disease) must be considered. Therefore, before every operation, a complete blood examination, including a blood count and a Wassermann test, and an examination of the entire body should always be made.

In children it is also necessary to consider an encephalocele, and in cases of rapid increase in exophthalmos, hæmorrhages (Barlow's disease) which very often simulate an acutely inflamed mucocele of the nasal sinuses. These hæmorrhages have the appearance of an orbital phlegmon or an acute orbital inflammation. Immediate operative interference is indicated in such cases.

Cysts of the orbit are very common, such as dermoid cysts, at or near the orbital wall, often imbedded in a niche of bone, honey cysts, and occasionally blood cysts.

In the last few years a great number of chronic inflammatory tumor like processes have been recognized. These develop slowly on certain parts of the orbital tissues and seem to originate especially in the lachrymal gland. The etiology is obscure, but because the process may extend to the second orbit, it should be removed like a genuine tumor by operation, if the general and roentgenological treatment fails. In such cases one must also consider the presence of chronic sepsis, therefore it is necessary to take the temperature and make a bacteriological examination of the blood.

The borders of these inflammatory tumors are not sharply demarcated, and they must not be radically removed.

<sup>1</sup>Translated by S. J. Meyer of Chicago, voluntary assistant in the German University Eye Clinic, Prague, Czechoslovakia.

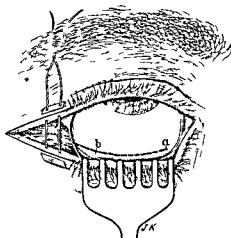


Fig. 1 Incision through the conjunctiva of the tumor 1 near the equatorial region of the eyeball. The canthotomy wound is closed by a silverplate suture

#### PREPARATION

General examination should be made for diseases of the nose and face such as acne or furunculosis which might be the original source of the infection and should be treated beforehand. The mouth should be made aseptic. The eyelids and their surroundings should be shaved and painted with two applications of tincture of iodine.

I always wear the head lamp while operating for only with such a light is the operator able to move freely and yet obtain a good view into the depth of the orbit.

#### ANÆSTHESIA

Local anæsthesia is indicated only in cases of small tumors and those situated anteriorly close under the lids or conjunctiva. A needle 4 centimeters long is inserted close to the lateral orbital border in the direction of the optic canal and is aspirated back. Should blood come the syringe is withdrawn as injection into a blood vessel must absolutely be avoided. Two cubic centimeters of a 2 per cent novocain solution with the addition of a few drops of adrenalin is injected toward the apex of the orbit (ciliary ganglion). A similar injection is made by the insertion of the needle over the medial palpebral ligament. In withdrawing the point of the needle a little novocain is also injected along the medial orbital wall. If after 5 minutes the anæsthesia is not sufficient a similar injection should be made along the roof of the orbit. I prefer general narcosis with ether with a preparatory injection of 4 centigrams of pentopon or 2 centigrams of morphine because local injection swells the orbital contents and in-

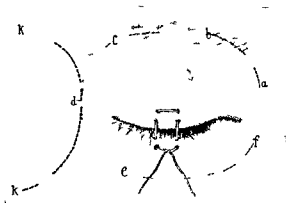


Fig. 2 Positions of the various skin incisions. *a b c d e f* Orbital margin incision. *a b* Orbital margin incision for a tumor situated superiorly and medially. *b c* Orbital margin incision for a tumor situated superiorly and laterally (lacrimal gland). *c d* Orbital margin incision for a tumor situated superiorly and laterally. *d e* Orbital margin incision for a tumor situated laterally and inferiorly. *e f* Orbital margin incision for a tumor situated inferiorly. *k k k* Skin incision for a Kroenlein operation. The palpebral fissure is closed by means of a bridge suture. The eyebrows are naturally shaved. They are only shown in the illustrations more clearly to indicate the position of the incisions.

creases the difficulties of the operation. When I use general narcosis I induce anæsthesia of the surrounding tissues of the orbit by novocain injection in the region of the incision or of the supra orbital nerve.

The orbital tumors can be reached in three different ways: (1) through the conjunctival sac (in very rare cases), (2) by means of an incision through the skin, or (3) by exposure of the orbital structures through temporal resection of the lateral orbital wall after the method of Kroenlein.

#### I. OPERATION THROUGH THE CONJUNCTIVAL SAC

Approach through the conjunctival sac is to be considered only when the tumor is in proximity to the eyeball in the anterior parts of the orbit without being fixed to the eyeball and is small and does not go deep into the orbit. Therefore it is applicable only in rare cases.

When the tumor is located deep in the orbit the operative procedure is as follows:

In the lengthening of the palpebral fissure the outer lid commissure is cut through close to the orbital border with the scissors (canthotomy) while the lid is held fast with the forceps and the other connections of the lids (lateral palpebral ligament or relatively the tarso orbital fascia) are cut through upward and downward close to the orbital border with the scissors. This is done so that the lids can be moved quite freely. Then

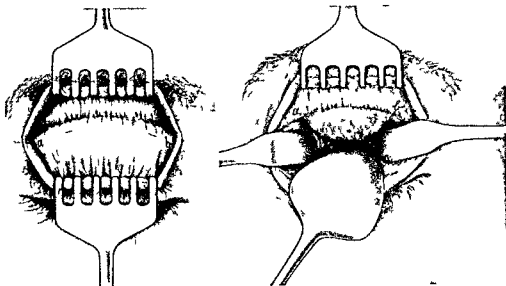


Fig 3 (left) Freeing the upper orbital margin *a b* Incision through the fascia tarso orbitalis in tumor of the upper orbit

Fig 4 Tumor of the roof of the orbit *a b* Incision through the periosteum, if the tumor is to be extirpated in connection with the periosteum or the bone

a suture placed through the skin and the conjunctiva and loosely tied, stops the bleeding and serves at the same time as a bridle suture to control the lids. Then the lids are retracted with the bridle suture or with blunt hooks placed between the lid margins corresponding with the position of the tumor, and a sufficiently large incision is made through the conjunctiva on the fornix (Fig 1)

After the insertion of sharp wound retractors in the conjunctival wound, and after hæmostasis has been effected by the use of adrenalin tampons, or forceps, the operator dissects bluntly with the closed scissors onto the tumor, and grasps the tumor with hooked forceps and shells it bluntly out of the orbit. If there are many blood vessels on the surface of the tumor, they are clamped at a moderate distance from the tumor with artery clamps, and cut on the tumor side and tied. If the tumor cannot be easily shelled out, one carefully inserts the index finger (covered, of course, with a rubber glove) into the orbit and palpates for the location and size of the tumor. While the tumor is pulled forward with forceps, an artery clamp is inserted about  $\frac{1}{2}$  centimeter behind the posterior border of the tumor and the tumor is separated from its pedicle. If this exposes many blood vessels, they should be tied with silk. All the eye muscles with which one comes in contact (also the rectus inferior, obliquus inferior, and eventually one or both of the lateral recti) must be carefully preserved and drawn aside with blunt hooks. This is the procedure if the tumor is in the lower part of the orbit

If the tumor is in any other situation, the incision through the conjunctiva corresponds to the position of the tumor. The degree of success naturally depends upon the nature of the tumor, especially whether it is sharply defined or not. Quickly growing malignant tumors are never shelled out in this manner with any kind of surety. One can consider this operation only for cases of benign connective tissue tumors such as fibromata, lymphangiomata, and hæmangiomata, and thick walled cysts, such as dermoid cysts and honey cysts. However, in the case of hæmangioma, radical extirpation is as a rule not possible, as here the bleeding is best controlled by cauterization with the Paquelin. A small drainage tube is placed in the wound and directed to the side between the lids. Throughout the operation, the cornea must be kept moist, it may be frequently covered with the intact upper lid and moistened with physiological salt solution. It is also recommended that during the operation the cornea be covered with coagulated blood.

After satisfactory hæmostasis has been effected, the conjunctival wound is closed with a continuous suture, and the canthoplastic wound is exactly approximated and sutured with silver plated wire (Fig 1). The conjunctival sac is washed out with iodine (Pregl) solution. If the conjunctiva is not perfectly free of bacteria, the site of the tumor should be washed out before the wound is sutured. To determine the presence or absence of bacteria, a bacteriological examination is made before operation. A pressure bandage is applied over the closed lids and the other eye

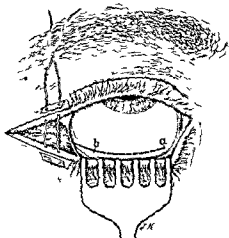


Fig. 1. Incision (a) along the conjunctiva if the tumor is near the equatorial region of the eyeball. The canthotomy wound is closed by a plate suture.

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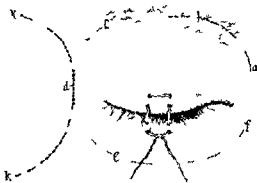


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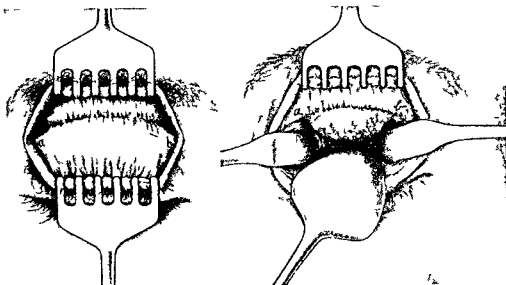


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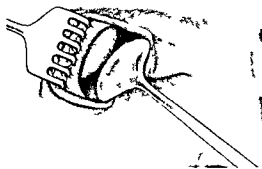


Fig 3 Lachrymal gland tumor exposed by orbital marginal incision (Fig 1 c d)

should also be kept closed for 2 to 3 days. If there should be no irritation the conjunctival sac is irrigated daily with iodine or mercury oxycyanide (1:5000) solution. After 5 to 6 days the sutures are removed and the bandage is left off.

A tumor below the levator in the upper half of the orbit cannot be reached by this method without destroying the levator. There one can reach the tumor by means of a dissection from the lateral parts of the orbit best by the third method.

## II. OPERATION BY MEANS OF AN INCISION THROUGH THE SKIN

This procedure is suitable only for tumors in the neighborhood of the entrance to the orbit if they lie outside the muscle cone and it is suitable for tumors in the upper circumference of the orbit only if the tumor lies between the levator and the upper orbital border; therefore this operation is applicable in cases of tumors arising in the perosteum or bone. It is especially applicable in the cases of the ivory exostoses of the orbit produced by diseases of the nasal sinuses or of tumors from the accessory nasal sinuses protruding into the orbit.

The preparation of the patient is similar to that used for any surgical operation. The upper eyebrow, forehead, temples and the bordering skin of the cheek are shaved. When the operation is to be extensive and temporal resection of the lateral wall after Kroenlein has to be carried out the anterior third of the hair of the head on the side operated upon should be shaved. The site of operation is painted with tincture of iodine and anesthesia induced. The lid opening is closed temporarily with a mattress suture through the upper and lower lid with the skin folded over for a distance of  $1\frac{1}{2}$  centimeters (Fig 2).

If the tumor lies in the upper circumference of the orbit the incision should be made in the upper eyebrow. In every case the incision should be made preferably a little outside of the bony border of the orbit that is, not in the lid region or if medial not in the region of the lachrymal sac. In Figure 2 the various incisions are seen to be circular incisions and each incision is designated by letters.

The incision is made down to the bone without cutting through the perosteum. The bleeding is controlled then the tarso orbital fascia is immediately incised after the wound margins are retracted with broad pointed retractors (Fig 3 a b). If the operator is not experienced in orbital operations or if the case is complicated the free edges of the tarso orbital fascia are secured with a bridle suture of No. 1 silk and then laid to the side. Then sharp pointed retractors are inserted and by gentle dissection with scissors the anterior borders of the tumor are exposed. The procedure now differs according to whether the tumor originates in the orbital wall or in the orbital structure itself. Tumors of the orbital wall usually originate in the accessory nasal sinuses.

*Tumors of the bony wall of the orbit.* After the introduction of the sharp retractors, the tumor is exposed and freed posteriorly by blunt dissection with an elevator or closed scissors. A comparatively large orbital spatula (Fig 4) is then inserted and the borders of the tumor defined posteriorly and laterally. It is also recommended that at this time the operator palpate the orbital structures with the finger after having changed to fresh rubber gloves. If the region of the trochlea must be exposed it should be loosened with a piece of perosteum and neighboring bone so that it can be placed aside in the soft orbital tissue.

At a sufficient distance from the outer anterior border of the tumor the perosteum is incised (Fig 4) and loosened with a rasp on all sides for a distance of about 1 centimeter. In the region of Figure 2 a b one also has to cut through the supra orbital nerve if the tumor is situated in this position. The perosteum is then separated anteriorly from the healthy bone with a straight chisel and hammer so that the anterior borders of the tumor are exposed. The perosteum of the orbit is thus left attached to the tumor. Only in rare cases of ivory exostoses which are absolutely benign, can that part of the perosteum of the orbit which touches the tumor be loosened and preserved with the soft parts of the orbit. By gentle chisel blows the bone is separated on both sides and finally at the posterior border of

the tumor, a broad orbital spatula is inserted, with, if necessary, a smaller one on each side. In these cases, the accessory sinuses are usually also diseased, and it is best to expose them by punching or chiseling away the anterior wall, and to curette the mucous membrane with a sharp curette. In these cases, it is advisable to make a broad opening into the nasal cavity. The wound is then flushed with iodine (Pregl) solution.

When an accessory sinus is opened, it is packed with iodoform gauze, and the tampon is led out either through a corner of the wound or through the nose. In the latter case the skin can be completely sutured, and if no communication with the nose exists, a drainage tube can be inserted near the strip of iodoform gauze.

Then the orbital fascia is closed with two or three fine silk sutures, and the skin wound is closed with deep and superficial sutures. In the case of a small tumor, if no accessory sinuses are opened, the wound can be completely closed without tampon or drain. If one is not certain of sepsis, or if bleeding is not fully controlled, it is better after flushing the wound with the iodine solution, to insert a drain from a corner of the wound down into the depth of the orbit. The drain is removed after 48 hours if no pus has formed. Slight oozing of blood is controlled by a pressure bandage over the closed eye. If evidences of infection appear, such as swelling of the orbital tissue, edema of the bulbar conjunctiva, exophthalmos, and rise in temperature, the wound should be opened to its full extent, washed thoroughly with iodine (Pregl) solution, and kept open with xeroform gauze or sterile gauze impregnated with the iodine solution.

If the tumor extends posteriorly in the region of the orbital roof, the dura mater is often exposed. If the new growth encroaches upon the dura or frontal lobe, a resection of the latter is done. In this case, after the application of the iodine solution, broad strips of gauze should be laid on the defect in the brain and dura, and led out in a broad strip while the skin incision is closed only partially on both sides. If the accessory sinuses have also been opened, they are packed with iodoform gauze, which is led out separately as far as possible from the gauze covering the brain.

In tumors on the medial orbital wall, the incision lies as much as possible above the inner lid margin (Fig 2, a, b). The lachrymal sac is loosened out of its fossa by bringing it forward, if possible, without injury to the lachrymal duct or sac. Then the periosteum is separated over a wide area posteriorly. As a rule, in malignant

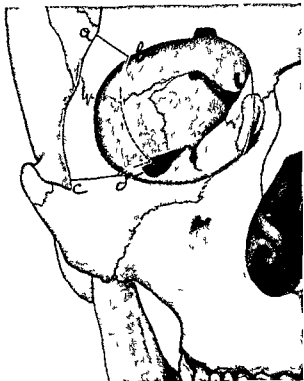


Fig 6 a b Upper, c d lower periosteal incision b d marginal periosteal incision. Dotted line shows incision through the lateral wall of the orbit.

tumors of the medial orbital wall, the lachrymal sac is also diseased and should be removed with the tumor. In tumors of the lower inner part of the orbital wall, one must avoid the inferior oblique muscle (Fig 2).

**Postoperative treatment.** The wound is covered with vaseline impregnated gauze and the bridge suture of the lids is left in place if there is much exophthalmos, if no exophthalmos is present, the sutures are removed, the lids are well padded, and a pressure bandage applied. If drains and tampons have been used, they are removed after 2 days, and renewed if there is oozing or pus in the wound.

Unless it causes irritation, gauze packed on the brain should be left in place 6 to 8 days.

When the tumors are situated in the orbital tissues, but outside the muscle cone, the skin is incised, the fascia tarso orbitalis divided, and the tumor freely exposed by careful blunt dissection. In the case of possibly malignant tumors, one attempts to keep as large a layer of tissue as possible on the tumor. When the tumor is hard, it is usually advisable to make an exploratory puncture, as very often dermoid cysts or honey cysts are thickly encapsulated and have the appearance of tumors. In the presence of many blood vessels, the procedure is the same as that formerly described.



It is usually possible to expose the tumor by inserting deep in the direction of the eyeball a broad orbital spatula and if necessary small orbital spatulas laterally (Figs 4 and 5). If it is found at the operation that the tumor extends farther posteriorly into the orbit than the former examination revealed it is necessary to continue with a Kroenlein temporal resection of the orbit. Also when the tumor lies medial to the eyeball the orbital spatula can be used to push the eyeball and soft parts far enough away so that the approach to the operative field is broad and entirely free.

In many cases I have dissected free only the periosteum at the orbital border made an incision along the brow and through the periosteum pushed it back anteriorly and posteriorly with a rasp and removed the bony border with Iuer bone cutting forceps. This method is especially applicable when the tumor is in the deeper parts of the orbit. Often by this method one can make a sufficiently large approach into the deeper part especially when the orbital ridge is very prominent. This approach is possible only along the upper and outer wall of the orbit. Care must be exercised not to open the frontal sinuses. Cosmetically the small defect in the bone does not have to be considered.

If the tumor is relatively large and has resulted in marked limitation of motion of the eyeball and oedema of the optic nerve (choked disk) or if the tumor is apparently possibly malignant the patient's permission should be secured to do an exenteration of the orbit. If it is possible only to expose the tumor in the anterior parts by a small incision on the orbital border an exploratory excision is made for histological study. Such an exploratory excision is usually advisable and the diagnosis should be made immediately, if possible from the frozen sections. If the tumor is malignant much of the surrounding tissue must be extirpated and the eye muscles sacrificed. If the tumor is very large and encroaches upon or includes the eye muscles or eyeball, it is advisable to sacrifice the eyeball and remove the anterior part of the orbital structures or the whole orbit. Should the tumor be attached to the periosteum it is absolutely necessary to remove it by cutting through the healthy periosteum and removing the tumor with the periosteum. Before the tumor is removed an orbital spatula is inserted about 1 centimeter from the tumor. Should the bones not be absolutely intact or should it be a case of malignant tumor of the orbital tissue (sarcoma) the bordering bone is carefully removed with a curved chisel injury to the neighboring accessory

sinuses being avoided. The rest of the procedure has already been described.

### III. TEMPORAL RESECTION OF THE OUTER BORDER OF THE ORBIT THE KROENLEIN OPERATION

In all tumors of the soft orbital tissues which lie far posterior in the orbit or are retrobulbar it is necessary first to expose the orbital contents by a temporal resection of the lateral wall of the orbit by the method of Kroenlein. I then proceed in the following manner:

After a skin incision is made (Fig 2 *k k*) a periosteal incision is made at both the upper and lower ends of the lateral orbital wall (Fig 6 *ab cd*) the periosteum is dissected free for a short distance both upward and downward, with the periosteal elevator then a third periosteal incision is made along the lateral wall of the orbit (Fig 6 *bd*). Bluntly one loosens the periorbita from the whole lateral orbital wall until the inferior orbital fissure is reached. Then after hæmorrhage is obtained the orbital wall is cut through with the circular saw first below then at the upper border in a horizontal direction (Fig 7) while the orbital contents are protected by an orbital spatula. The rotation of the circular saw is directed outward so that if it should slip it would not strike the orbital structures. The lateral wall of the orbit is cut through with the straight chisel and hammer from the inner side in the form of a triangle the apex of which is at the inferior end, while the orbital spatula is inserted from the upper and lower saw cuts into the inferior orbital fissure. Injury to the large vein lying in the inferior orbital fissure must be avoided. If such injury should occur the bleeding can be stopped by the insertion of a small adrenalin sponge. Then the entire mobilized bone is pulled outward with a resection hook and is covered with sterile gauze.

The rest of the procedure depends entirely upon the position of the tumor. If the tumor is situated in the outer half of the orbit or in the muscle cone it can be reached through the Kroenlein incision. If it should be more toward the medial half of the orbit, the Kroenlein skin incision is lengthened by an incision along the orbital margin either above or below according to the location of the tumor. An incision should be made in the periorbita almost corresponding to the incision in the orbital border in the lateral half of the orbit. From the middle of the incision an incision is made vertically backward with the scissors or scalpel (Fig 8) and both ends of the incision are caught with a broidle suture and pushed bluntly sideways. The procedure from

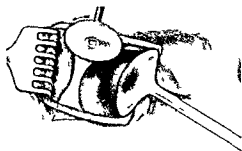


Fig 7

Fig 7 Incision of the orbital margin with the circular saw. The dotted line indicates the position of the lower periorbital incision.

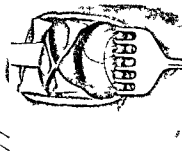


Fig 8

Fig 8 Kroenlein operation with the lateral orbital margin tilted outward. The dotted lines indicate the position

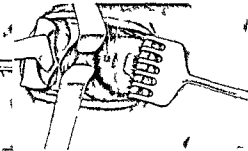


Fig 9

of the incisions in the periosteum of the orbit which are made to expose the orbital contents in the lateral half of the eyeball.

Fig 9 The rectus lateralis is tied and incised to allow better access to the contents of the muscle cone.

this point depends upon the position of the tumor.

**Tumors outside the muscle cone** If the tumor should be situated outside the muscle cone, the periorbital incision is drawn back both upward and downward with a blunt retractor, then the tumor is bluntly dissected free with closed scissors, and caught with rat toothed forceps. If the tumor is malignant it is isolated directly around the tumor capsule or isolated some distance from the capsule, according to the probable degree of malignancy.

Bleeding blood vessels are ligated, and finally, if possible, when the tumor is not fixed posteriorly, it is removed by blunt dissection from the orbit. If bleeding should occur, it can be stopped by quick tamponade. In this way the tumors of the tear gland, which are of the most frequent occurrence, can be easily shelled out. When the tumor has been freely isolated anteriorly it is forcibly pulled forward, the posterior part of the tumor is palpated with the fingers, an artery clamp is inserted about 1 centimeter behind it, and the blood vessels in the stump are caught before they are cut through with the scissors. Ligation of the vessels is as a rule not necessary, but if it should be required, the silk sutures are carried into the depth of the orbit with two forceps. Usually the bleeding can be stopped after the artery clamps are removed, by brief tamponade. As a rule tumors of the lacrimal gland reach into the outer upper fornix border of the conjunctiva or are attached to it, so that they are excised with it, that is, the conjunctiva is "button holed." Such a "button hole" can be immediately closed with one or two fine silk sutures.

**Tumors in the muscle cone** When the tumor is in the outer half of the muscle cone, the rectus externus is freed by blunt dissection. It is then grasped about  $1\frac{1}{2}$  centimeters from its tendon

with a blunt muscle hook, and pushed aside, so that with the insertion of a second strabismus hook on the opposite side or a small orbital spatula, the tumor is freely exposed. If the tumor is not then approachable, that is, if it is situated in the deeper medial half of the muscle cone or in the optic nerve sheath, the rectus externus is made fast  $\frac{1}{2}$  centimeter posteriorly from its tendon insertion by a loop of thread, fastened, cut with the scissors between the insertion and the loop, and laid aside (Fig 9). Free tumors in the muscle cone can then be bluntly shelled out. When sight remains in the eye, one must avoid any approach to the optic nerve in the lower and inner circumference with possible injury to the central artery and vein of the optic nerve which enter and leave this part of the nerve. In optic nerve sheath tumors, which are usually benign, the eyeball is grasped at the rectus externus tendon with rat toothed forceps, and rolled inward. The optic nerve is separated close to its entrance to the optic canal with one stroke of the large curved scissors. Then the eye is rolled about and the nerve cut through close to the entrance of the optic nerve into the eyeball with scissors or knife. The bleeding is controlled by the insertion of an adrenalin tampon and forcible pressure on the orbital tissue for a few minutes.

One should never forget to remove the tampon before closing the wound!

Then the rectus externus is resutured to its tendon with 2 or 3 fine silk sutures, the orbital tissues and fat replaced into their former position over the rectus externus, if possible, and the periosteum of the orbit sutured into its correct position with 2 to 3 fine silk sutures. If the eyeball or conjunctiva has been exposed during the removal of the tumor, one should attempt to place between it and the periosteum of the orbit or the lateral wall as much orbital tissue or fat

tissue as is possible and if necessary to fasten it to the desired parts by the finest silk sutures. The latter is particularly important because very often the rectus externus grows onto the Kroenlein incision and thereby remains paralyzed. The bone flap is then replaced as well as possible. It is well to have small sterilized pieces of wood handy with which to mold the lateral orbital wall should it for any reason be hard to manage. As a rule manual reposition is sufficient. Both horizontal periosteal incisions are sutured with fine silk.

When suturing the skin incision one should be careful to get as nearly as possible all the neighboring cell and fat tissues into the first deep sutures after which the skin wound is closed with superficial sutures. If this is neglected the skin becomes attached to the bone and the orbicularis muscle remains permanently weak. Particularly in cases in which a second orbital border incision is combined with the Kroenlein incision such neglect can lead to an elephantiasis like severe chronic edema of the lids.

*Tumors in the medial half of the orbit.* When the tumor lies in the medial half of the orbit a second orbital border incision should be made immediately after the lateral orbital wall has been reflected back. The distance of this incision from the Kroenlein incision depends upon the position of the tumor. This step in the technique has already been described. Then the tarso-orbital fascia is incised parallel to the orbital border incision and the tumor freed with blunt forceps and closed scissors as previously described. The procedure is made easier by mobilizing the eyeball well outward with an orbital spatula by means of which the operative field is made more approachable. The rest of the procedure has been described but attention must be drawn to the fact that one must avoid the trochlea and lachrymal sac. When the approach is along the medial and lower wall of the orbit extreme care must be exercised to avoid injury to the bony wall including the lamina papyracea of the ethmoid the lachrymal bone and the roofs of the antrum of Highmore which are very thin in children and old people and must not be fractured.

#### EXENTERATION OF THE ORBIT

When a tumor involves the eye muscles or the surface of the eyeball and it is found at exploratory operation to be malignant with the result that the tumor with the very thick connective tissue capsule and surrounding cellular and fatty tissue cannot be removed exenteration of the orbit is done.

This can be done in two ways

1 If the skin is intact the lids and conjunctiva can be preserved. Then one performs a canthoplasty and the eyeball is isolated by dissection of the bulbar conjunctiva as for enucleation. An incision is then made with the scissors from the lateral border of the cornea along the entire conjunctiva together with the outer lid commissure up to the orbital border. The incision is continued behind the conjunctiva above below and around and up to the periosteum with a scalpel. The periosteum on all sides of the orbit up to the apex is loosened with a rasp and periosteal elevator and the entire ball of the orbital contents drawn forward and removed with scissors as far behind the probable end of the tumor as possible, directly at the apex of the orbit. A large tampon previously prepared is pressed into the apex of the orbit in order to stop the profuse bleeding from the ophthalmic artery and vein. It is often necessary, if one is convinced by an examination of the extirpated tumor that the tumor is attached to the bone at any point or at the apex of the orbit and it has not been entirely removed to remove the corresponding parts of the bone with chisel and hammer, as previously described. It is often necessary to stop the bleeding immediately with the Paquelin cautery. The canthoplastic and conjunctival wounds are closed with silk sutures a xeroform gauze tampon being led out from the orbit through an opening in the middle of the wound. This can be left in for days. If no fever occurs it can be loosened after one week and the opening made smaller by compression on the conjunctiva and skin of the lid.

If the conjunctiva and skin of the lids are partly included in the tumor the skin is excised for a distance of about 1 centimeter from the tumor the normal parts of the lids are incised  $\frac{1}{2}$  centimeter outside of the lid border the remaining skin of the lids is dissected free about to the orbital border the periosteum is incised on the orbital border and loosened from the bony wall and from here on the entire orbital contents are removed, as previously described. The tear ducts are removed at the same time and the tear sac is shelled out of its fossa and removed. After a tampon has been inserted, the skin of the lids must be sutured up to the point where the tampon is led out.

Should the lids be completely destroyed, as often happens when a carcinoma grows out from the lid, the large orbital defect is best covered by a thick Fricke flap clear to the periosteum slid down from the forehead. The naked periosteum on the forehead is covered with a Thiersch

graft. In such cases, frequently the whole orbit need not be extirpated, the anterior parts of the orbit including the eyeball being sufficient. In most cases a skin prosthesis (wax or rubber) can be inserted directly or fixed by means of spectacle frames.

One naturally decides immediately upon an exenteration when the vision has been seriously impaired by optic atrophy or optic neuritis, or when motion will probably be greatly disturbed by the encroachment of the new growth upon the eye muscles. Even if the tumor could possibly be

made retrogressive by roentgen rays, still tumor rests might lie hidden in the orbital tissues and grow rapidly or metastasize.

In cases of melanotic tumors of the orbit, the radical total exenteration of the orbit is very probably indicated. The lids must be sacrificed if the new growth has reached the conjunctiva and the skin of the lid.

In all cases in which the tumor can be suspected of malignancy the operation is followed by roentgen ray therapy and the patient kept under observation for at least a year.

## FROM THE SURGICAL CLINIC, LAKESIDE HOSPITAL

## THE TECHNIQUE OF CARDIORRHAPHY

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From the Department of Surgery, Western Reserve University School of Medicine and the Lakeside Hospital

THE suture of cardiac wounds is the accepted therapy of such disasters. Ten years after his first successful case, Rehn (5) was able to collect 124 cases in which suture had been performed, with 40 per cent recovery. In 1920 Tuffier (9) assembled 305 cases with 50.4 per cent recovery. Smith tabulated 58 cases collected from the literature between 1912 and 1923 with 66.6 per cent recovery. These figures speak for themselves. They disclose one of the brilliant epochs in the advance of surgery. Although the opportunity to suture a wound of the heart may come but rarely, every surgeon should acquaint himself in the surgical laboratory with the technique of handling the heart and applying sutures to a wound. This is not the occasion for discussing the diagnosis of a wound of the heart. It may be mentioned however that cardiac tamponade is of fundamental importance in the diagnosis of the condition and its mechanism should be understood.

## ANÆSTHESIA

The choice of the anæsthetic depends upon the individual case. Inhalation anæsthetics do not seem to be harmful. Many cases of cardiorrhaphy and pericardiostomy have been done under local anæsthesia and many under the various inhalation anæsthetics. Patients with wounds of the heart have been operated upon in a moribund condition without any anæsthetic at the beginning of the operation. The statement should be made however that every operating room where such surgery may be performed should be equipped with some form of apparatus for administering positive pressure to the lungs. At the present time most machines used in the administration of anæsthesia, whether ether or nitrous oxide and oxygen are equipped with a pump through which the gases can be forced under pressure into the lung. When positive pressure sufficient to insufflate the lung is used it is usually unnecessary to place a tube in the trachea through the larynx but this also may be necessary. Our experience with the operation of median sternotomy in which the pleuræ are not opened convinces us that in this operation positive pressure is unnecessary. In the use of any of the many parasternal incisions which open the pleural cavity however, it would

seem wise to be prepared for insufflation of the lung.

## EXPOSURE OF THE HEART

Adequate exposure of the heart is essential and this in face of the fact that the moments necessary to provide adequate exposure may seem of vital importance to the perpetuation of the heart beat. When the pericardium is opened and the tamponade relieved the heart may regain a vigorous action within a few systoles. If the exposure of the heart be inadequate one may open the pericardial sac, see the heart recover, and then be faced with the terrifying situation of a vigorous heart action shooting out great jets of blood and yet be unable to locate the leaking point. Since Rehn's (5) first successful case of cardiorrhaphy in 1896 much has been written about methods of exposure. The various methods proposed may be grouped into two chief types: (1) median incisions which split the sternum and do not enter the pleural spaces and (2) parasternal incisions. The parasternal incisions include osteoplastic flaps and intercostal incisions of varying magnitude. They enter the pleural cavity and are especially useful in cases in which there is combined injury of the left lung and the heart. They do not afford full exposure of the heart because the right auricle and most of the right ventricle are inaccessible by this approach. The median sternotomy incision though more time consuming protects the pleural cavities and affords full exposure of the heart.

*A. The median incision (Fig. 1).* This exposure was first developed by Milton of Cairo (4). It has been modified repeatedly and in its most satisfactory form has been described by Duval and Barast (3) as the median thoraco-abdominal pericardiostomy. In this operation the incision lies in the midline anteriorly and reaches from the second rib to within a few inches from the umbilicus. It is carried through to the bone and to the linea alba. The linea alba is divided to the sternum, the ensiform is freed or removed, the diaphragmatic attachments beneath this are separated from the sternum and the index and third fingers of the right hand are thrust upward beneath the sternum to separate the tissues that lie beneath it. Having freed the substernal tissue

as far up as possible, a flat spatula is introduced which protects the underlying viscera. The sternum is then split in the midline to the second interspace. We have found that this can be accomplished most rapidly with a motor driven circular saw, but it may also be done with a pair of large bone cutters, such as Schumacher shears. At the level of the second interspace, the sternum is cut across, either with a saw or with shears. One should guard against injury to structures beneath the sternum by constantly keeping a flat retractor beneath it as it is cut. Great care should also be taken in the transverse division of the sternum so that the internal mammary vessels are not injured. They often lie within a centimeter of the sternal edge. In our experience, the straight cut obtained by the saw is preferable to the jagged cut obtained by a shear, because in closing the wound more accurate approximation of the sternum with silver wire sutures can be obtained. This reduces the amount of pain during the period of convalescence because with each respiration the movements of the cut edges of the sternum are painful.

We have found, as indicated by Milton (4) in his classic paper, that it is better to incline the sternal incision slightly to the left from above downward. This keeps the incision more surely over the "uncovered" triangle (triangle of safety, Voimitch-Sionojentsky) thus protecting the pleuræ against injury and affords a better view of the left auricle and left ventricle.

After the sternum is split and cut across and the linea alba is divided, the two halves of the sternum can be pulled apart with retractors. As this progresses, the pleuræ should be wiped away with gauze from the anterior chest wall lest they tear when the exposure becomes sufficiently widened. At this stage, full exposure cannot be obtained until the diaphragm is divided. A self retaining retractor is now placed. We have found the retractors devised by Tuffier or by Lilienthal very satisfactory. The anterior pericardium is widely opened to the diaphragm, the peritoneum is then opened over the liver to the diaphragm, and the abdomen protected with warm moist pads. Care is taken so that the incision travels somewhat to the left, and the inferior pericardium and diaphragm are split inward almost to the crura. When this has been done, the retractor may be opened quite widely.

An excellent exposure of the heart is obtained. The methods for the proper handling of the situation from this step on are described below. After closure of the wound in the heart has been accomplished, the apposition of the parts is completed

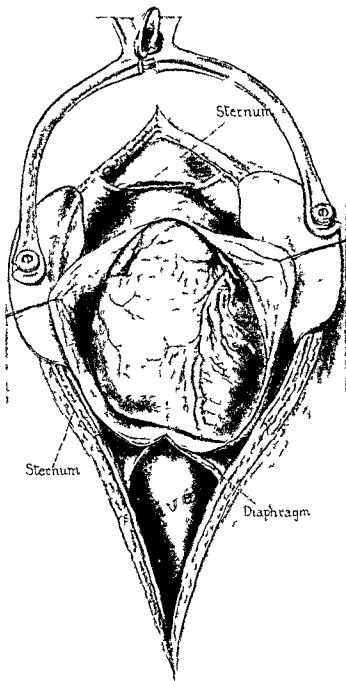


Fig. 1. Exposure of heart by median sternotomy.

as follows. By reducing the amount of traction, the inferior pericardium and diaphragm may be closed with a continuous suture. Then the anterior pericardium is approximated with a continuous suture from above downward, this suture being tied about 1 inch from the diaphragm, so that a small rubber tissue or gutta percha drum may be left in the wound to this point for 24 hours. The retractor is then removed and three drill holes are made opposite each other in each half of the sternum through which silver wire sutures are placed. The

<sup>1</sup>The illustrations are taken from an article by Dr. Beck in the *Archives of Surgery*.

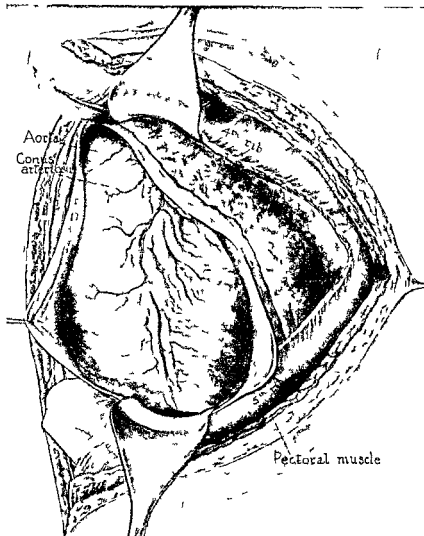


Fig 2 Exposure of heart by intercostochondral thoracotomy

linea alba is next closed with interrupted sutures and the two halves of the sternum are brought together and the silver wire sutures tightened. The skin and subcutaneous tissue may be approximated in layers.

*B The parasternal incision.* Operations for exposure of the heart and pericardium were first performed with left parasternal incisions. Larrey used such an exposure in 1810 when draining an infected pericardial wound. Romero in 1819 drained three cases of purulent pericarditis through a similar incision.

Since that time a great many variations of the left parasternal incision have been developed. They are well reviewed by Terrier and Raymond

(8) Matas and Tuffier. Some authors used a simple intercostal incision, some resected ribs, some turned osteoplastic flaps or trap doors in one direction or the other, and some combined these methods with partial removal of the sternum. It seems out of place to give all these procedures in detail here and we have therefore selected from this large group that method which seems to us the simplest and best. The limitations of all lateral incisions have been emphasized. We have selected the Spangaro<sup>1</sup> intercostochondrotomy in

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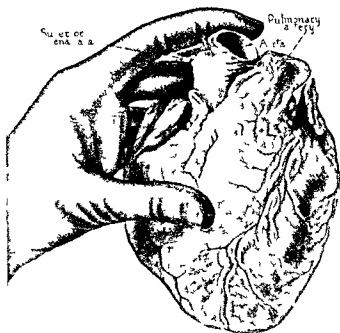


Fig 3 First step in method of controlling flow of blood through heart by compression of base third finger is placed through great transverse sinus fourth and fifth fingers are placed posteriorly in pericardial cavity by compression with the fingers the venæ cavæ and the pulmonary veins can be occluded

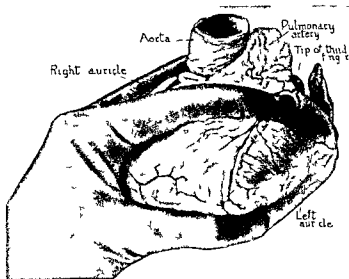


Fig 4 Second step in method of controlling flow of blood through heart by compression of base the heart is steadied between the thumb and the index finger

cision as the most useful among the great group offered (Fig 2) This intercostal incision with its possible enlargement by division of the costal cartilages at the point of attachment to the sternum was used independently by Durante and Wilms and has received the enthusiastic endorsement of Rehn and Salomon

In this procedure, the incision is made in the left fourth or fifth intercostal space, extending from the anterior axillary line to the sternum where it may continue upward and downward along the margin of the sternum to expose the third, fourth, fifth, and sixth costal cartilages. The incision is carried through to the pleura. The internal mammary vessels are isolated, ligated at the upper and lower limits of the wound, and divided between the ligatures. The third, fourth, fifth and sixth costal cartilages are divided close to the sternum. The incision is then extended through the pleura, the lung being kept distended by positive pressure insufflation if necessary. If there be active bleeding from the lung, it may be advisable to suture the wound of the lung before artificial inflation is carried out, because hæmorrhage is usually less marked when the lung is collapsed. The ribs are then widely separated and held retracted by some form of self retaining retractor. The pulmonary field can be walled off with warm moist packs. For this purpose, one

should use silk handkerchiefs covered with vase line, or cotton moistened in salt solution. The pericardium is opened according to the lesion present, either longitudinally, which makes closure simpler, or horizontally. It is well to have silk traction sutures on either side of the pericardial wound for identification later and for traction during the operative procedures.

This incision gives excellent exposure of the left lung and the left side of the heart including the left auricle and ventricle. It only partially exposes the right ventricle (Ballance found it ample in his case), offers no exposure of the right auricle and does not give a very satisfactory view of the left auricle. The venæ cavæ are inaccessible and, therefore, one cannot control hæmorrhage by pressure upon the vessels entering the heart at the base. The exposure is sufficient, however, to permit direct compression of the ventricles in the grasp of the operator. The exposure may be enlarged by the removal of a portion of the sternum, and it has even been proposed that the sternum be completely divided transversely.

This method of approach is indicated in cases in which the wound has penetrated the left pleural cavity, in which there is combined injury of lung and heart. The steps to be taken in closing the wound in the heart are described below. Wounds of the lung usually can be controlled by deep mattress sutures, gently tied and approximated. Experience seems to indicate that the pericardial wound should be drained. The pleural wound, however, should be closed without drainage. A running suture will suffice for the partial closure of the pericardium. The retractor is then removed



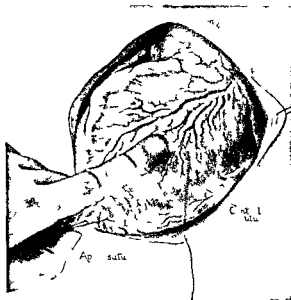


Fig. 5 New method of suture control of hemorrhage from the wound preparatory to suture. Showing the suture in the apex of the heart and the position of the control suture traction on the apex suture steadies the heart so that the index finger can be maintained effectively on the wound a control suture is being placed

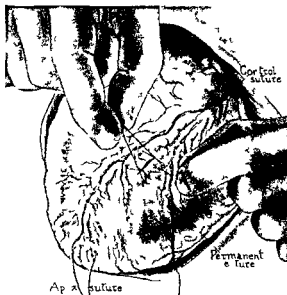


Fig. 6 Second step in new method the control sutures are crossed and held under gentle traction by the assistant hemorrhage can thereby be controlled and a good exposure of the wound is provided. The permanent sutures can be placed so that adjacent coronary vessels are avoided and a satisfactory approximation of the wound is obtained

and the ribs allowed to reassume normal position which they will tend to do. The pleura can then be approximated by a running suture which includes the intercostal muscles as well as the pleura. It may be necessary to place one or two silver wire or heavy chromic catgut sutures about the two ribs nearest the opening to make the approximation more secure. Such wounds heal well. *A tight swathe adds to the comfort of the patient.* Should blood or fluid accumulate in the pleura it can be removed by aspiration as indicated.

#### SUTURE OF THE WOUND

The steps to be taken after exposure has been accomplished depend upon the extent site and type of injury present. In cases of perforation of the cardiac chambers the pericardial sac will be found full of blood and as soon as pressure is released by opening the pericardium fresh blood will spurt into the wound or engulf the field.

If the injury is very large it will be necessary to use Sauerbruch's (6) method for the temporary arrest of the circulation while placing the necessary sutures (Figs 3 and 4). This procedure is carried out as follows. The left hand is placed in the region of the base of the heart the third finger passing through the great transverse sinus above the cavæ and pulmonary veins and beneath the

aorta and pulmonary artery the fourth and fifth fingers rest on the auricles beneath these structures as the third finger is approximated to the other two the flow of blood into the heart is stopped and when this has been accomplished pressure with the index finger and thumb may be exerted to steady the organ and deliver it into the field. Sutures should be placed as rapidly as possible and with this in mind should be prepared in sufficient number as soon as the operation starts. Great care however should be taken not to injure the coronary vessels. We prefer to use interrupted silk sutures but others have used chromic catgut with success. If much time has been taken during the process of suturing it is well to release pressure at the base of the heart intermittently so that some blood may flow into the coronary vessels.

If the wound be small we believe the following method recently described by one of us (2) is far less deleterious to patients and should give more satisfactory control without the danger imposed by the manual trauma of Sauerbruch's procedure. This method is carried out as follows. As soon as the exposure is completed a suture should be placed in the apex of the heart and the threads held in the left hand of the operator. By means of this suture the heart can be steadied without compression. The index finger of the left hand is

then placed over the wound to control bleeding. With the blood flow thus controlled, the rest of the procedure may be more deliberately carried out. Two deep sutures should then be placed parallel to the long axis of the wound. As these threads are crossed and made taut, the finger is removed, and the tension exerted by the pull of the threads will control all bleeding (Fig. 5). The situation is then in hand, and the final sutures passing from one side of the wound across to the other may be laid with precision and care (Fig. 6). We have used in our experimental procedures, fine silk threads on French needles and have found this material satisfactory. Such a procedure is of value when the wound is in close proximity to a major coronary vessel the inclusion of which in the suture might result in ventricular fibrillation.

We should like to emphasize that inserting the finger into the cardiac opening is a dangerous procedure. It was found, as pointed out in a previous article (2), that to control the bleeding by this method frequently called forth so much pressure upon the finger that the cardiac muscle was torn, the wound accordingly enlarged, and the difficulties of the procedure augmented. In several experiments, exsanguination occurred before the wound could be sutured. Furthermore, the presence of a finger in the wound added to the difficulty of placing a satisfactory suture. Because of its marked friability, cardiac muscle cannot withstand inclusion in clamps and forceps, and such instruments should not be applied.

We would advise the surgeon to acquaint himself in the laboratory with the handling of the pulsating heart. It will be found that the heart

can tolerate manipulation very well, and with experience can be handled much as any other structure of the body. For any manipulation of the heart we should like to emphasize the value of a suture placed in the apex. By means of this suture the heart can be steadied in any position and the index finger can be maintained effectively upon a bleeding wound. Compression of the heart in the grasp of the operator is usually unnecessary as is also shutting off the flow of blood through the heart by compression of the vessels at its base.

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## A POINT IN TECHNIQUE FOR THE SUPRAVAGINAL REMOVAL OF A MYOMATOUS UTERUS WITH A FOUL UTERINE DISCHARGE<sup>1</sup>

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WHEN carcinoma of the body of the uterus is present we make it a rule to sew up the cervix from below prior to going in above and removing the entire uterus. The vagina is then

packed with gauze so that the uterus is pushed well up into the abdomen.

Recently at the Johns Hopkins Hospital I had a patient who had a myomatous uterus and a

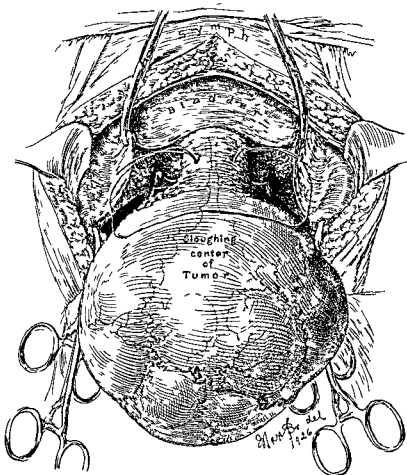


Fig. 1. Passing a mattress suture through the cervix as a preliminary to a supravaginal hysterectomy, to prevent the escape of purulent uterine contents into the peritoneal cavity (Schematic). In such a case whether a supravaginal hysterectomy or a complete operation is done, there is great danger of subsequent peritonitis. In the case reported, speed was essential on account of the patient's weakened condition, and by doing a supravaginal operation considerable time was saved. All vessels have been controlled and the cervix mobilized. A mattress suture of catgut has been placed, each end of the suture being introduced from before backward. The suture is tied behind. (See Fig. 2.)

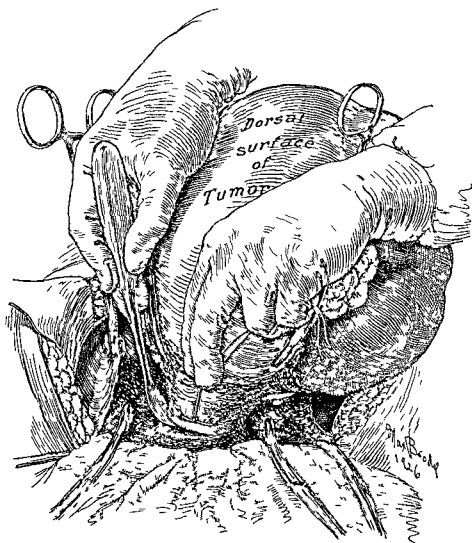


Fig 2 A mattress suture closing the cervical canal and effectually holding back purulent uterine contents. Viewed from above (Schematic) The cervix is being cut across from left to right. Hardly a drop of discharge was seen when the uterus was amputated.

foul uterine discharge. She had suffered from hæmorrhages and the hæmoglobin was 15 per cent. After a purin diet of liver, kidney, and pancreas the hæmoglobin rose to 40 per cent. Notwithstanding the use of radium, bleeding again commenced, the hæmoglobin dropped to 35 per cent and it was necessary to insert packs.

When I saw her there was a most fœtid vaginal discharge and I was afraid that an abdominal operation might cause a general peritonitis. On account of the patient's precarious condition I felt it wiser to amputate through the cervix because this procedure would save a good deal of time. On the other hand, there was danger that the uterine contents might escape as we cut through the cervix.

I finally decided to pass a mattress suture through the cervix and tie it, and thus block

the cervical canal above the point of amputation.

After tying off the ovarian and uterine vessels and isolating the cervix I carried the stitch from before backward through the cervix. Then after rethreading the loose end I carried it back through the other side of the cervix. It was much easier to introduce both ends of the suture from before backward. I then tied the suture on the posterior surface of the cervix. The uterus was now amputated below the point of suture and not over a drop of fluid escaped from the cervical canal. The patient made a satisfactory recovery.

The suture is easily placed. Figures 1 and 2 show the manner in which it is applied.

This procedure, I think, will reduce the chance of infection in such cases to a minimum.

## THE USE OF IODIZED OIL IN THE DIAGNOSIS OF PULMONARY LESIONS<sup>1</sup>

By SAMUEL IGLAUER M D F A C S CINCINNATI OHIO

**I**N February 1923 Sicard and Forestier announced their important discovery that a fluid contrast substance lipiodol could be safely introduced into the bronchi as an aid to chest roentgenography. Lipiodol consists of poppy oil combined with 40 per cent iodine which renders it opaque to the X rays. The work of Sicard and Forestier (24 25) in bronchography was soon confirmed by numerous observers in their own country and by German Danish Russian English and American investigators.

The American literature contains interesting and instructive reports by Ballon (3) Archibald (2) Clerf (6) Grady (12) Pritchard (22) Whyte, Gordon Furstenberg and Hickey (11) and others.

In April of this year I presented a paper on this subject (14) and described a specially devised double barreled intubation tube through which the iodized oil can be readily introduced (Fig 1). I also demonstrated the use of opaque media as an aid in the delineation of subglottic stenosis.

In addition to lipiodol two other iodine preparations are available. The German iodized oil is marketed under the name iodipin (17) and the Danish preparation has been named iodumbrin (21). All three preparations consist of a vegetable oil combined with about 40 per cent of iodine by weight. I have used all three preparations and have found no marked difference in their radiopacity nor in their effect upon the patient. Iodipin is somewhat more viscous than the other two oils but this viscosity presents no obstacle when the oil is properly warmed.

Recently Dyroff (8 9) has reported on the (intra uterine) use of a new preparation, contrastol in which bromine instead of iodine is combined with a vegetable oil. He claims that brominated oil is less irritating than the corresponding iodized compound and states that both animal and clinical experiments have proved that contrastol is entirely free from injurious properties.

### METHODS OF INTRODUCTION AND ROENTGENOGRAPHY

Before injecting the oil the larynx and tracheo-bronchial tree must be properly anesthetized. The oil may then be introduced with a laryngeal syringe or by puncture through the cricothyroid

membrane. Beck and Sgalitzer (5) advocate the introduction of a catheter into the trachea while both Haslinger (13) and Lorev (20) introduce a small bore radiopaque tube which is guided under fluoroscopic control into the lung area to be injected. Josefson (16) attaches a syringe to a tubular tongue depressor the tip of which rests at the epiglottis. The lipiodol is injected while the patient makes inspiratory movements. Singer (26) employs a somewhat similar technique.

Ballon (4) and Clerf (6) prefer the bronchoscopic method. I have also frequently employed the bronchoscope but think it should be used only when cultures or specimens are to be taken or when direct inspection is desirable. I have found my air and oil intubation cannula technique to be very simple and practicable and applicable to both children and adults (Fig 1).

In most cases the oil is injected under the guidance of the fluoroscope. By varying the position of the patient the opaque fluid may be caused to gravitate into the most dependent portion of the lung including the apex. The apex is infiltrated by placing the patient on his side. Very frequently the diagnosis can be established from the fluoroscopic image alone. Anteroposterior, stereoscopic, and lateral views should usually be taken. It is sometimes advantageous to take films with the patient in both the upright and recumbent position especially when fluid levels are to be demonstrated.

From the combined experience of many observers sufficient data have been accumulated to enable one to properly evaluate this method of diagnosis. The limitations of the method as well as the indications and contra indications to its use have been fairly well established.

### BRONCHIECTASIS

The most brilliant results have been obtained in the detection of bronchiectatic cavities which very frequently are not discernible on the ordinary X ray film. Since these cavities are almost always situated in the lower lobe of the lung which region may be injected with the greatest ease the clinical diagnosis of bronchiectasis may be confirmed or disproved with reasonable certainty. The various stages of the disease from its early manifestations to its full blown development may now be studied



Fig 1 Double barreled air and oil intubation tube *in situ* (II), rubber tube projecting from the patient's mouth and attached below to the oil channel (III) The oil is injected through the rubber tube, with the patient in any position desired

in the living Furthermore, the introduction of iodized oil frequently has a favorable effect upon the clinical course of these cases as reported by Abramowitsch and Tichomirow (1) and others

In bronchiectasis the earlier lesions appear upon the film as cylindrical dilatations of the smaller secondary bronchi The more advanced lesions appear as club shaped, fusiform, sacculated or grape like distention of the involved bronchi and bronchioles (Fig 2) The lesions may be unilateral or bilateral The unilateral cases often give a history of a previous pneumonia or an empyema in the affected area In the bilateral cases the lesions on one side are usually much more advanced than on the other A site of predilection is found in the lung field situated behind the heart shadow a region which hitherto has been almost a "no man's land" to both internist and roentgenologist (Fig 3)

This method of diagnosis has also shown that the bronchiectatic process may begin during childhood, as demonstrated by Dehille (7), who detected a series of crises of bronchiectasis in children who had been confined in a tuberculosis sanatorium under a mistaken diagnosis of tuber-



Fig 2 Veteran of the World War aged 38 Dull pain in chest Shortness of breath and profuse expectoration since 1917 Examined in U S Diagnostic Center No 1 in 1926 Diagnosis of lung abscess complicated by bronchiectasis, confirmed by lipiodol injection

culosis My youngest patient was a girl of 13 Her history indicated that the disease process had begun 6 years before, following an attack of influenza (Fig 4)

#### TUBERCULOSIS

Because the lesions of pulmonary tuberculosis are multifiform, the injection of iodized oil reveals some very unusual pictures which are often not visible in the ordinary films The trachea will frequently be found to deviate markedly from the midline owing to the traction of a fibrotic upper lobe The left main bronchus may be hooked up by a similar traction force so that it becomes curved with the convexity downward I have ventured to call the pseudo cavity thus formed a reservoir bronchus Not infrequently small and sometimes even large cavities will be revealed for the first time after injection On the other hand, at times, known cavities cannot be filled with oil probably because of the absence of a wide drainage bronchus

Injections have demonstrated the frequent occurrence of small bronchiectatic cavities in the tuberculous lung These may be situated in the upper as well as the lower lobes (Fig 5) Such cavities are in all probability a secondary manifestation of the disease process The line of demarcation between a thickened pleura and an infiltrated lung can be demonstrated to advantage

Finally the injected lungs give the thoracic surgeon valuable information as to the comparative condition of the two lungs before and after

the surgical procedures now so commonly employed in the treatment of pulmonary tuberculosis

Notwithstanding the advantage of the increased visibility in the tuberculous lung after injection experience has shown that such a lung cannot always be injected with impunity. This is especially true since some of the frequent complications of pulmonary tuberculosis may be attributed falsely or otherwise to the introduction of the opaque medium.

The early investigators of lipiodol expressed some fear that the endobronchial injection of the oil into the tuberculous lung might activate the disease process or set up congestion and excite hæmorrhage and therefore they usually refrained from making such injections. Forestier however on his visit to this country expressed no such opinion and showed no hesitancy in making the injections in the cases of tuberculous patients. Both Ballou and Archibald in a series of cases employed lipiodol freely for diagnosis and as a guide to thoracic surgery. Recently however they have established special indications for its use.

Jacobaeus (15) expresses no misgivings as to its use in the tuberculous and finds it valuable as an aid in chest surgery. For example he refrains from severing pleural adhesions when the lipiodol demonstrates that the adhesions are intimately connected with the underlying bronchi.

The only recorded microscopic postmortem studies of the effect of lipiodol in the tuberculous pleura and adjacent lung tissue are those of Fiesinger and Lemaire (10). The lipiodol had previously been injected into the tuberculous pleural cavity. They found that the lipiodol does not penetrate the organized tuberculous lesions but that cells filled with lipiodol enter infiltrated areas. They state that it is possible that this absorption of lipiodol favors parenchymatous sclerosis but this fibrosis is accompanied by a congestion more diffuse and much more marked than one observes in ordinary pulmonary sclerosis. It does not produce true fibrosis of the tuberculous lesions themselves but only a neighboring sclerosis. Their observations indicate that in an area of active evolution the lipiodol may favor the diffusion of the lesions.

Lichtwitz (19) reported a single case of pulmonary tuberculosis previously rather stationary in which 4 cubic centimeters of lipiodol seemed to activate the disease and urged caution in employing it in this class of cases.

Personally I have been actively associated with and have been able to follow 13 cases of pul-

monary tuberculosis and 2 cases of tuberculous pleurisy in which iodized oil was introduced into the bronchi. Eleven of these cases were sanatorium patients. Eight were kept under observation by Dr W C Breidenbach of the Dayton Sanatorium and 3 were observed by Dr H K Dunham and Dr Vera Norton of the Cincinnati Tuberculosis Sanatorium. I have notes on the 4 remaining cases of the series. While it is beyond the scope of this paper to consider these cases in detail it may however, suffice to enumerate the sequelæ which may have had some relation to the injection.

One case under sanatorium care for approximately 4 years showed a large basal cavity previously undiscernible in the X ray. The patient improved after the first injection and requested a second treatment with lipiodol. Following the latter he had a very considerable reaction then improved rapidly but succumbed to a hæmorrhage one month after the last injection. A second patient showed blood in the sputum for several days after injection but subsequently did very well and is still improving.

A bed ridden patient with a history of an acute extensive pulmonary involvement of uncertain origin and nature showed tubercle bacilli for the first time after the iodized oil had been introduced. The patient died 10 weeks later but it is doubtful if the injection hastened the end.

A case with a thoracoplasty suffered considerably from a flare up of an old myocardial insufficiency. Another patient with an artificial pneumothorax was very dyspnoæic for many days following the injection as would naturally be expected with one lung completely compressed and the lipiodol invading the air spaces of the opposite lung.

A very interesting observation was made in 3 cases (1 mentioned above) in which tubercle bacilli appeared in the sputum for the first time after injection thus establishing the diagnosis in 2 cases and confirming it in the third. This reaction is doubtless comparable to the release of tubercle bacilli by the therapeutic administration of potassium iodide and may prove of value in doubtful cases.

The remaining cases showed no permanent sequelæ which could be attributed to the oil. Several of them had a febrile reaction, lasting from 1 to 10 days after which several patients showed considerable improvement.

Viewed as a whole this series of cases is not very encouraging. While the sequelæ noted above may not have been due to the introduction of the oil and might readily have occurred in the natural



Fig 3 Lateral view showing numerous sacculated bronchiectatic cavities in the retrocardial lung field. Chief complaint, arthritis since 1918. Empyema and rib resection in 1913. Patient of Dr. K. Haly.



Fig 4 Lateral view showing retrocardial club shaped bronchiectatic cavities in a girl aged 13. The history indicates that the disease process began 6 years ago following an attack of influenza.

course of the disease, still they throw the burden of proof on the operator. I can, therefore, only agree with Dr. Breidenbach when he says "It would be well to adopt the following rule on the use of lipiodol in tuberculous cases, that while it is not absolutely contra indicated in tuberculosis, still there should be some definite end to be gained, for instance, the demonstration of a difficult cavity, etc., rather than just general information as regards lung structure." It is also contra indicated in cases of active tuberculosis.

The employment of brominized animal oil is still in the experimental stage. The recent preliminary report of Putnam (23) indicates that brominized oils are less irritating than similar iodine combinations and that halogenated animal oils are "less irritating, more easily emulsified, and more quickly absorbed than the vegetable oils at present in use." If these experiments are confirmed by clinical experience, it may be found advantageous to substitute these newer preparations especially in tuberculous subjects.

#### LUNG ABSCESS AND FISTULA

It is rather difficult to fill the cavity of a lung abscess. Unlike the tuberculous or bronchiectatic

cavity the pulmonary abscess does not stand open and probably drains chiefly by overflow. As a result the injected oil cannot enter the space already filled with purulent secretion. In lung abscess in particular, the use of the bronchoscope is invaluable since the pus may be aspirated through the bronchoscope and the opaque medium may then be introduced with greater ease and certainty than by other methods. The easy filling of an abscess is one indication that the abscess may be amenable to treatment by bronchoscopic aspiration. When the abscess is situated in the periphery of the lung and has poor drainage into the bronchi it may be found impossible to inject the cavity.

On the other hand if the cavity has been opened and is draining through a fistula in the chest wall, injection of the opaque medium through the fistula will give an excellent delineation of the cavity and its connections (Fig 6). It is important to inject the fistulous tract with a local anesthetic before the oil is injected, in order to abolish the cough reflex and thus prevent the expulsion of the opaque fluid. The fluoroscope should be employed while the injection of the opaque medium is being made.





Fig 5 Pulmonary tuberculosis showing traction displacement of the trachea toward the right side with numerous small bronchiectatic and tuberculous cavities in the upper lobe

In the same manner bronchopleural fistulae may be delineated to great advantage. The injection of the iodine may prove beneficial. In a case reported by Moeller and von Magnus (21) the fistula which had a very slight tendency to heal closed within 3 weeks after the injection.

#### TUMORS

When tumors of the pleura or lung parenchyma are present the injected bronchi usually either terminate abruptly at the site of the tumor or seem to be pushed aside by the growing neoplasm.

In mediastinal growths just below the tracheal bifurcation the angle of bifurcation may appear considerably wider than in the normal (Lenk, Hrsinger and Presser 18).

#### PLEURISY

In a case of pleurisy, with effusion the injected lung if free will be seen to be floating on the effusion and the limits of the effusion may come out clearly on the film. When the X-ray failed to determine the localization, extent or biloculation of the effusion Fiessinger and Imaire (10) employed an ingenious method of delineating the upper and lower borders of the effusion. They injected a heavy and a light lipiodol into the effu-



Fig 6 Bronchiectatic and pulmonary abscesses injected through a catheter (indicated by arrow) inserted into a thoracic fistula. Patient of Dr. George Heuer

sion. The heavy oil sank to the bottom of the exudate while the light oil floated at the top. The use of lipiodol in the study of the structure of pleuritic adhesions in artificial pneumothorax cases has been mentioned above (Jacobaeus).

#### SUMMARY

1 The use of iodized oil as a contrast medium is of great value in chest roentgenography.

2 The oil may be introduced perorally by several methods including the use of the laryngeal syringe, the special intubation tube, the bronchoscope and the flexible catheter. It may also be introduced by puncture through the cricothyroid membrane, but this method is not recommended.

3 The bronchoscopic method is preferable when specimens are to be taken, abscesses are to be evacuated, or direct inspection is desired.

4 Injection under the guidance of the fluoroscope gives visual control and frequently establishes the diagnosis before films are taken.

5 The most gratifying results have been obtained in the detection of bronchiectatic cavities.

6 The multiform lesions of pulmonary tuberculosis are usually extraordinarily clearly shown.

7 Experience indicates that iodized oil may at times activate tuberculous lesions. Therefore in tuberculosis it should be used with caution and only when some special information is to be gained, for example, such information as is desirable before thoracic surgery is undertaken.

8 Brominized oil is less irritating than iodized oil and future experience may show that its use is to be preferred especially in tuberculous patients

9 Injected iodized oil is of considerable value in the diagnosis of pulmonary abscesses, fistulae, tumors, and pleural effusions

I desire to express my appreciation to Dr Samuel Brown and Dr George Benzing for their painstaking roentgenographic work in connection with this paper

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# THE METHOD OF CHOICE FOR THE CORRECTION OF SADDLE NOSE<sup>1</sup>

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IN this paper I desire simply to relate the results of my personal experience for the correction of saddle nose and to discuss the arguments which underlie my opinion. At first I will say that for this kind of operation I prefer to practice autoplasty by means of costal cartilage. Indeed since the war particularly almost all the surgeons have abandoned the metallic prosthesis (gold silver platinum aluminum), for reasons which are now well known to us.

White vaseline (Gersuny 1900) and paraffine (Eckstein, 1901)—and later on a mixture of these two substances—gutta serena and rubber have been with reason put aside.

Rueda's attempt (1913) to introduce under the skin a bundle of catgut for the correction of saddle nose had no imitators.

The same can be said of periosteum (Reverdin, 1879), muscle (Vignard) and fascia (Fritz Koch, 1914) because all these grafts as well as catgut are absorbed more or less rapidly, and as a consequence do not give any æsthetic result.

Besides the inorganic substances already referred to I must also mention celluloid which has had a certain vogue for many years. In 1890 Fraenkel began to use it for cranioplasty. In rhinoplasty it was Foderl who employed this substance the first in 1903. If this foreign body is often tolerated by the tissues of the nose we must however admit that it is a little irritating and that in many circumstances it is sooner or later eliminated.

In 1918, Joseph of Berlin the great initiator of nasal plastic surgery in Europe advocated ivory for the correction of saddle nose. This organic material is now well known to us especially since the researches of Carnot who has demonstrated that its chemical composition very much resembles that of human bone. However it is well to remember that there is on the market an inorganic pseudo ivory having a vegetable composition which is liable to produce irritation and must not be employed. Pure ivory can render great service, because it is generally well borne after having been encapsuled by fibrous tissue. In other circumstances on the contrary, even if the operation is performed to perfect aspect principles it is not perfect.

irritation and is not tolerated. Being very hard this prosthesis must be manipulated with saws rasps and other special instruments and for this reason we must admit that its use is rather complicated.

As to animal grafts it is recognized by all authors that they are always absorbed and are replaced by fibrous tissue of new formation which gives no cosmetic result or at best a very poor one. In order to make these animal grafts more resistant Magitot conceived the idea of immersing them in a 20 per cent formalin solution for 8 or 10 days nevertheless I believe that before their stability is established they must undergo the test of time.

Israel in 1895 first employed the tibial crest in rhinoplasty. Since then Germany commonly employed from the leg are in favor of contact with the nasal bone. In order that it is performed if these observe I graft is Should operation variably.

To introduce the tibial crest into the nasal cavity for the correction of saddle nose is a simple operation. The nasal prosthesis is placed in the nasal cavity and the nasal bone is then placed over it. The operation is performed in the following manner: The nasal bone is first removed. Then the tibial crest is introduced into the nasal cavity. The nasal bone is then placed over it. The operation is performed in the following manner: The nasal bone is first removed. Then the tibial crest is introduced into the nasal cavity. The nasal bone is then placed over it.

not absorb, and that there was practically no sign of microscopic degeneration, whether the cartilage was or was not covered by its perichondrium. My regretted master, Morestin of Paris, one of the most skillful and expert operators in Europe, in plastic surgery of the face, also shared this opinion. Although some observers have found that after a certain length of time these transplants have a tendency to transform themselves into fibrous tissue, no one has claimed that they diminish in volume, which, from the cosmetic point of view, is most important. Furthermore, to increase their resistance, we know it is better to insert the grafts with their perichondrium. Naturally, the cartilage of the septum or of the ear, employed for the correction of small depressions of the nose, is much more liable to disappear than the large or small cartilaginous costal grafts, and experience has proved that such is nearly always the case.

When it is necessary to take a graft, almost all authors advise the sixth, seventh, or eighth rib. Following this operation, the pain is considerable, and the costal break takes much time to repair, therefore a certain number of patients refuse this kind of autoplasty. For many years I have used for the correction of saddle nose, the cartilage of the first floating rib. This cartilage that we can seize and freely move with the fingers, in the greatest number of patients, is very easily resected. The necessary incision for the removal is very small. Entirely covered by its perichondrium, it offers more resistance to fibrous transformation than any other transplant. For those patients who refuse general anaesthesia, the taking of the graft can easily be done without pain under local anaesthesia. If, in certain cases, the nasal concavity is so marked that we fear we will not be able to fill it with the cartilage alone, it is very simple to cut the entire rib. Carter of New York claims to obtain excellent results in rhinoplasty in employing osteocartilaginous grafts. For these reasons, I strongly recommend the use of the cartilage of the first floating rib, for the correction of saddle nose, as being the method calculated to give the best success. Moreover, we can assure our patients that after the operation, the side will not be very painful, thanks to the compressive bandage, and that at the end of 8 or 10 days they will be practically cured. During and since the war, I have many times used this technique, and I can honestly say that so far, I have not had any set backs. In support of what I have said, here are now 2 cases briefly reviewed.

CASE I. On January 19, 1925, A. B., 37 years of age, male, came to consult me for a saddle nose. He stated



Fig 1

Fig 2

that twelve years ago he was struck by a baseball on his nose, which was perfectly straight until then. The hemorrhage was treated by a general practitioner. About 3 weeks after the trauma, the inflammation going from bad to worse, a rhinologist made an incision for a suppurative hematoma of the septum. This hematoma healed up rapidly, but later on he noticed that his nose was becoming more and more concave. As the nasal fossae were obstructed after the accident, he had a minor operation on both sides of the septum 3 years ago. The intervention performed with a saw improved the breathing. The patient presents no manifestation of acquired or hereditary syphilis.

At the examination I found a symmetrical concavity of the lower third of the nasal pyramid. The lower part of the nasal bones is slightly flat (Fig 1).

Anterior rhinoscopy showed a septum absolutely straight. However, the septum opposite the trauma was a little thickened. As the turbinate bones were not hypertrophied, the breathing was not obstructed. Rhinitis and pharyngitis were shown by posterior rhinoscopy.

In face of this lesion I explained to my patient the different means for the correction of his saddle nose, and we decided to have recourse to the costal cartilage. The intervention was fixed for January 23 and I prescribed a nasal antiseptic saline.

As it was agreed that I should employ a piece of cartilage, I had to choose the spot best suited for its introduction. The operation of von Mangold (1889) which consists in making a cutaneous incision between the eyebrows at the inferior concavity, and forming a tunnel under the skin of the nose for the reception of the graft leaves, it is true, a slightly apparent scar. However, if there is even a slight infection, the drainage is rendered practically impossible, because the opening is above, and the graft is in danger of being eliminated.

Carter of New York, in 1910, modified von Mangold's method, by making a curvilinear incision at the superior concavity, as deep as the periosteum, which in turn was sectioned in a horizontal plane, and a recess made toward the glabella. The subcutaneous tissues being afterward freed as far as the tip of the nose, the graft

was placed in such a manner that its superior extremity lay under the periosteum of the nasal apophysis of the frontal bone. In 1919 Carter abandoned this method and adopted the endonasal route for the reason of drainage, as I have just mentioned.

In an effort to hide the cicatrix Leon Dufourmentel in 1919 conceived the idea of making the incision in the eyebrow. Frank and Strauss in 1921 described exactly the same method as new. Drainage by this method was also impractical. Owing to the length of the incision and the tunnel for the graft the operation and any manipulation of the transplant are rendered difficult.

In 1898 Monks of Boston advocated making an anteroposterior cutaneous cut under the tip of the nose extending slightly to the skin over the columella and afterward making a tunnel from below upward. J. D. Lewis in 1922 tried to take as his own Monks' method making slight modifications. He carries the same incision but a little more posterior opposite the columella, and in detaching the skin of the nasal pyramid he prepares at the tip of the nose a point of support for the inferior extremity of the graft when placed.

In order to reach the part of the nose to be repaired Portmann of Bordeaux (1923) made a curvilinear incision of about 3 centimeters which passed below the tip and then separated the tissues.

Always with the same idea and to obtain more space Gillies of London (1923) detaches all the skin over the columella in making an incision at the philtrum and at its junction with the mucous membrane of the nostrils and after having lifted this flap he forms a canal under the pedicle. I will say that with Monks' Portmann's and Gillies' methods the cicatrix is at first almost invisible. However considering the form of the nasal vestibule very narrow at its superior part and the thinness of the skin which covers the tip of the nose, I would very much fear that in separating the tissues of the nasal pyramid—even after the dilatation produced by novocain and adrenalin—the mucous membrane of the nostrils might be torn, an occurrence which would expose the patient to a secondary infection and to the elimination of the graft. In my opinion these methods should be reserved rather for the correction of thin hump noses because in these cases even if the wound became septic there would then be no serious consequences in view of the ease of drainage.

The endonasal incision made at the inferior border of the triangular cartilage advised by J. O. Roe of Rochester, New York in 1887—the

first to correct the different varieties of nasal deformities—represents without any doubt the ideal method now employed by a very great number of rhinologists in America and Europe. Indeed this process evidently leaves no trace of exterior cicatrization. It presents no danger of complications being at the same time easy of execution especially if we use the Joseph's concavoconvex knife to tunnel at the tip of the nose a recess with which to anchor the inferior part of the graft. If the nasal fossa, through which the incision is made has been prepared in an aseptic manner there need be no fear of infection. At first we might perhaps think that the suture of the lips of the incision might offer some difficulty. Such is not the case if we use the Dupuy Dutemps needle curved at a right angle to its handle with hemispheric form which he employs for the dacryocystorhinostomy. Furthermore Joseph of Berlin one of the cleverest and most skillful operators of our day in rhinoplasty who commenced in 1898 to use the external method of correcting nasal deformities has since 1904 used only the internal route. Because of all these considerations and my personal experience I chose for my patient this last method.

*Operation.* After having cut the hairy follicles of the vestibule irrigated the nostrils and applied tincture of iodine I injected a solution of novocain and adrenalin. A few minutes later I incised the mucous membrane of the left side at the inferior border of the triangular cartilage and fashioned a tunnel for the graft at the same time preparing a support for it at the tip of the nose. The patient was afterward chloroformed and I removed a piece of the cartilage from the first floating rib on the right side. This graft carefully shaped was placed under the skin of the nasal depression. After having squeezed out the blood I sutured the incision with silk. Iodoform gauze in the nostril exerted slight compression and in order to steady the graft I placed externally transversely to the nasal pyramid a small band of adhesive. Then I covered the face with a protective dressing. The costal wound was closed with three layers of sutures and the ordinary abdominal dressing applied. Postoperative sequelae were most simple and from the seventh day I gradually removed the stitches. Just a slight stiffness was felt during the first week and the patient left the hospital 16 days after the operation absolutely satisfied with the result obtained. His nose is straight as can be seen from the photograph (Fig. 2) taken one month after the rhinoplasty. I have seen him recently and his esthetic appearance has not changed.

*CASE 2.* C. L. male aged 24 years came to see me on April 27, 1926 for sunken nose. He said that he had never received a trauma and that since birth his nose had always had this shape the deformity increasing with growth.

On examination I found a flatness of the nasal bones and a depression at their lower border. The tip of the nose tilted up and soft had no support. The nostrils were much dilated especially the left one a condition which



Fig 3



Fig 4



Fig 5

gave the patient a negroid appearance. The lips were very prominent, also the chin (Fig 3).

By anterior rhinoscopy, I found that the two cavities were very large. The septum was straight but presented at its anterior part no cartilaginous resistance. The head of the inferior turbinate bones was slightly atrophied and there existed a double chronic rhinitis with abundant non odorous secretions.

Posterior rhinoscopy showed a pronounced pharyngitis.

The condition of the tonsils and of the larynx was normal.

The patient had suffered from a chronic suppurative otitis media since the age of 4 years.

I found no sign of acquired or hereditary syphilis and there was no tuberculosis in his family.

I therefore had to deal with a case of arrest of congenital development of the nasal skeleton which had to be corrected. Again this time I explained to the patient the various methods at our disposal for a successful result and we decided to take a piece of costal cartilage and introduce it by the endonasal route.

In the presence of this deformity, I considered Moulounguet's method (1920) which consists in making, by the external route, two incisions, one transverse under the tip of the nose, and another anteroposterior through the skin over the columella, the first being joined at its middle. After having made a subcutaneous canal, and splitting the septum, the author takes from the ninth rib a cartilaginous graft which he cuts into the shape of a square. This graft, applied in the operative wound, supports the tip of the nose, and at the same time, corrects the saddle back. However, in my case, the lack of development and the thinness of the nasal septum would have rendered the operation very laborious, and the slightest lesion of the mucous membrane, on account of the hypersecretion in the nostrils, would have surely produced infection, and consequently the elimination of the graft.

Sheehan's method could have been equally well applied. It consists in making an anteroposterior incision through the middle of the skin over the columella, from the tip of the nose to the philtrum. Having prepared a tunnel, Sheehan then inserts a piece of costal cartilage bent at a right angle at the tip of the nose. This graft has for its object, like Moulounguet's operation, the support of the tip of the nose in a good position, and moreover the filling up of the nasal depression. I have not adopted this method for the same reasons that I have already mentioned in connection with the question of the external incisions. Also, as a simple piece of rib well placed could give me the same cosmetic result, I adopted this method, and fixed the operation for May 6.

**Operation.** Having followed the same operative technique for my 2 patients I will not further repeat myself and will simply say that in this latter case everything turned out quite as normally as in my first case. When I inserted the graft in the nasal depression I was careful to see that the pressure was on the most concave part—the graft being cut in consequence—in order not to lower the tip of the nose but on the contrary to slightly raise it. Fifteen days after the rhinoplasty, the patient returned to his family absolutely cured after having suffered very little from his side during the first week. I continued to sterilize the nostrils with a saline and on June 7 my patient came again to the hospital to undergo the same day an operation for the correction of the dilated nostrils. The operative field having been made aseptic I injected a solution of novocain and adrenalin into the nasolabial folds. Instead of using the concavoconvex scissors to cut the nostrils a method usually employed in the United States I chose the bistoury, controlling the incision with the finger in the nasal fossa. Thus practiced this incision is much neater than that made with the scissors which have a tendency to crush the tissues the coaptation is better and the æsthetic result is more perfect. Also I removed from the two alæ of the nose a little triangular piece with

its base below limited by the nasolabial folds. At first I operated on the right side the least dilated and removed on the left a flap a little larger in order to obtain a symmetrical correction proportionate to the broadness of the face. I sutured with silk and adjusted an internal and external nasal dressing. I obtained a union by first intention and the patient returned home 10 days after the second operation. The incision hidden in the nasolabial folds was hardly visible the nostril were narrowed while allowing good breathing and the nose itself was quite straight as can be seen by Figures 4 and 5 made 3 months after the first rhinoplasty.

I have suggested to my patient diminishing the prominence of his lips by removing two ellipses of buccolabial mucous membrane on a horizontal plane however he refuses declaring himself much pleased with the result.

### CONCLUSIONS

For the numerous reasons that I have just mentioned the ideal method for the correction of depressed nasal deformities consists in making an internal incision and after having prepared a tunnel inserting a piece of the cartilage of the first floating rib. When the graft is placed in position the application of two little bands of adhesive transverse to the nasal bones would have the effect of fixing it and consequently offer better conditions for adhesion with the surrounding tissues. Carried out in this manner the operation will give greater chances of success than any other method.

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## A SUGGESTED METHOD FOR THE REPAIR OF CRUCIAL LIGAMENTS OF THE KNEE<sup>1</sup>

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THE method described of repairing either the anterior or posterior crucial ligament of the knee is suggested as an improvement over either the Hey Groves or the Putti method. The idea of this was first suggested to me by Dr Langworthy, of Spokane, who designed an operation for the repair of the anterior crucial ligament, whereby

of the tibia, starting approximately 1 inch below the joint line and going upward and backward, emerging in exactly the center line of the tibia and approximately one quarter of an inch from the anterior edge of the joint surface, not going through the cartilaginous portion. Another hole is now bored, by means of the same sized drill,

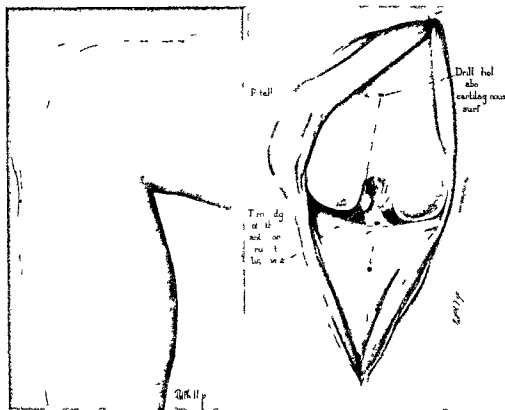


Fig 1 (left) Position of the knee and the Fisher patella displacing incision  
Fig 2 The patella displaced—the dotted line showing the line of drill holes for the insertion of the anterior crucial

he made use of the ligamentum patella. To repair a crucial ligament, it is necessary to have a rather wide exposure of the knee. This can be achieved perfectly well by the so called Fisher incision, which is a very long incision extending along the inner border of the patella. The patella, together with the soft structures on the inner side, as well as the tissues external to the incision, is displaced laterally and the knee flexed, and in this way a most excellent exposure of the knee is made (Figs 1 and 2).

By means of a rather large drill—one quarter inch—a hole is bored through the anterior portion

starting well above the cartilaginous surface of the femur and practically in the center line, going downward and forward and emerging on the outer side of the intercondylar notch, at a point where the anterior crucial is normally inserted. A piece of fascia lata, 5 inches long by three quarters of an inch wide, is now used to form the anterior crucial. This can be pulled through the holes, either by a wire loop or a heavy piece of silk sutured to the end of the rolled fascia (Figure 3). The ends of the fascia projecting through the femur and the tibia can now be sutured firmly in position. The type of suture material used here is

<sup>1</sup>Presented before the King County Medical Society



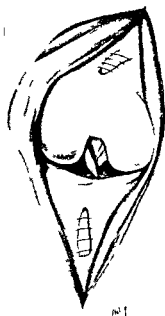


Fig 3

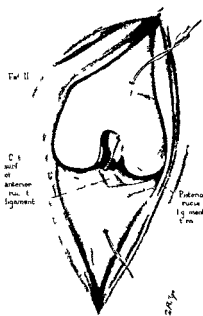


Fig 4



Fig 5

Fig 3 The anterior crucial sutured into position

Fig 4 Shows drill holes for the insertion of the posterior crucial In this case the drill hole through the femur should

emerge at a point somewhat posterior to the opening as shown in the picture

Fig 5 Posterior ligament sutured into position

not particularly important since we must depend upon the formation of bone around the piece of fascia to secure the proper firmness

A similar procedure can be used for repairing the posterior crucial ligament. The entrance of the drill into the femur and into the tibia may be at exactly the same point as would be used in the repair of the anterior crucial or it may be shifted to one side or the other which side is not important (Figure 4). The drill hole in the tibia goes upward and backward and emerges in the center line of the tibia approximately one quarter of an inch from the posterior margin (Figure 4). It is important that this opening be as far to the back as it is possible to put it. The drill hole in the femur goes downward and forward and emerges on the inner side of the intercondyloid notch at the point where the posterior crucial has its normal femoral insertion (Figure 4). A piece of fascia 6 inches long by three quarters of an inch wide is now rolled and pulled through the holes in the tibia and femur exactly as in the case of the anterior crucial and the fascia is secured in exactly the same manner (Figs 4 and 5).

The following points should be mentioned in favor of this operation

- 1 It is a very easy matter to get the required amount of exposure
- 2 The insertion of the ligament corresponds exactly to the normal insertion of the ligaments
- 3 The long transverse incision used heretofore is avoided
- 4 The material used is certainly as strong as the normal crucial ligament. The articular surfaces of the joints are not in any way disturbed
- 5 Finally it does not require such a high degree of skill as is required in either the Hey Groves or Putti operation and it is far more accurate

It is my belief that this operation is far better than anything heretofore described but it is far from being perfect. We can never hope however, that any operative procedure will imitate the close relationship that exists between the two crucials as well as between the crucials and the various other joint structures such as the infra patellar fat pad the internal and external semilunar cartilages and the synovial membrane

## HERNIA THROUGH THE FORAMEN OF WINSLOW

THE REPORT OF A CASE WITH REFERENCE TO THIRTY THREE OTHER CASES COLLECTED FROM THE LITERATURE

BY JOHN W DEWIS, A M, M D, AND RICHARD H MILLER M D F A C S, BOSTON

HERNIA of small or large bowel from the greater into the lesser peritoneal cavity through the foramen of Winslow is rare, and there are fewer instances of this than of any other form of internal concealed hernia. The condition is interesting not only on account of this rarity, but also because of its anatomy, pathology, symptomatology, diagnosis, and treatment. For this reason, we report in detail the case which forms the basis of this paper. We have found reference to only 33 cases in the literature.

Jeanbrau and Riche (14) in 1906 collected 18 cases, Ullman (32) brought this up to 30, in 1924, Delageniere (7) in the same year considered the subject fully and added 1 case of his own, making 31. One case reported by Corry (6) is not included in these lists, nor is another described by Copenhagen (5). We can, therefore, bring the present number reported up to 33, and, adding our own, make a total of 34. The first 30 of these are reviewed in some detail by Ullman, and it seems more feasible to refer the reader to his excellent article (32) than to enumerate these cases here. Brief reference, will, however, be made to those not recorded by him, and the other cases will be cited when they are relevant to the phases of the subject as they arise in this paper.

## THE ANATOMY, PATHOLOGY, AND ETIOLOGY

The foramen of Winslow lies just below and behind the portal fissure of the liver. It can easily be reached by running the finger along the gall bladder and cystic duct behind the free edge of the lesser omentum. Its boundaries are behind, the vena cava, covered with peritoneum, above, the caudate lobe of the liver, below, the hepatic artery and the first portion of the duodenum, and anteriorly, the free border containing the common duct, portal vein, and hepatic artery. Thus it is seen that the structures composing its walls are of vital importance, and surgical modification of its dimensions is fraught with danger. The only actual surgical measures ever designed have been proposed by Jeanbrau and Riche (14), and will be referred to later. The foramen is only a potential canal, its walls normally lying in contact. It easily admits the forefinger, or at times, two fingers. With a foramen of normal size,

and the intestines and mesenteries normal, a hernia through this opening should not occur, and it is fair to assume, with Copenhagen (5), that one of the following anomalies must be present: (1) common mesentery for the whole intestinal canal, (2) absence of secondary fusion of cæcum to the posterior abdominal wall, (3) abnormally large foramen, or (4) abnormally long mesentery with undue mobility of the intestine.

Violent muscular exertion, with straining, has been assigned as an immediate cause in many of the cases, and in this connection, the large majority of them have been in men. It seems to us, however, that this is only a casual relationship—that it is rather a case of *post hoc, ergo propter hoc*. But, if a loop of intestine is lying right at the mouth of the foramen, we think it possible that at such a time any violent spasm of the abdominal muscles might force the bowel into the lesser peritoneal cavity.

Brief histories of the cases not hitherto reported follow.

CASE NO. 32. Corry (6). A Hindu woman aged 30 who had been sick for 5 days was seen with the usual symptoms of intestinal obstruction. The whole abdomen was distended but swelling was especially marked in the epigastrium and around the umbilicus. At operation, three feet of small intestine were found herniated through the foramen of Winslow. This was pulled out by traction, and the patient recovered.

CASE NO. 33. Copenhagen (5). The patient was a woman of 56 with symptoms of acute intestinal obstruction. At operation it was found that the cæcum and ascending colon had herniated through the foramen of Winslow and had then perforated through the anterior layer of the lesser omentum and lay in front of the stomach. After the bowel had been emptied through a needle, the hernia was reduced and a catheter inserted in the bowel. There was marked relief of symptoms at first but the patient died shortly after and autopsy revealed a volvulus of the large bowel which had been released from the hernia.

AUTHOR'S CASE. A woman of 42 was seen on August 9, 1924, 20 days before this (on July 20) while doing her housework. She was seized with epigastric pain. This was soon relieved by vomiting—the character of the vomitus was not observed. She was then free of all symptoms for two weeks when on August 4 she was again taken with an attack of epigastric pain. Before either of these attacks she had done no work requiring muscular exertion and there had been no straining at stool. The pain was so severe that 3 hours after its onset morphine and atropine were required to obtain relief. During the night the pain returned and again necessitated the administration of morphine. It was most marked in the right upper quadrant,



Fig 1. Hernia through foramen of Winslow. A schematic representation of the hernia as observed in reported cases.

radiated downward and was somewhat relieved by enemas. By morning the pain recurred and continued during the day. Enemas gave no relief now and there was no passage of feces. The next day, August 7, the condition had not changed. There was no vomiting. Enemas were still given. Later in the day the temperature rose to 102.4 degrees F. The pain also increased and there was tenderness in the right upper quadrant of the abdomen. On August 8 there was a normal bowel movement. *At 10 she vomited* (again appearance of the vomitus not noted). After vomiting there was relief from pain—the first spontaneous relief in 4 days. On August 9 the symptoms had grown worse. There was great epigastric distress and pain, fever and chill, and thirst. This pain extended through to the back, and the patient got some relief from it by taking the knee chest position.

**Physical examination.** (3 p.m.) A small, pale woman lying in bed, weary and restless, temperature 99.8, pulse 84, respiration 18. The eyes were sunken, the pupillary equal, breath offensive, tongue dry, sordes on teeth, no enlarged gland, heart, lung, and patellar reflexes were normal. There was no edema anywhere.

**Abdomen.** Upper portion full, especially over epigastrium and to right. Tenderness from ensiform to umbilicus and in gall bladder region; in the tense epigastrium there was a vague, indefinite mass dull to percussion; the rest of the abdomen was mostly tympanic. The cecum and a cecocolon seemed filled with fecal matter. Appendix scar was present. The muscles on the left side of

the abdomen were lax and the sigmoid was contracted and hard. Rectal and vaginal examinations were not done.

Blood: Hemoglobin 80 per cent, white count 15,800. Smear showed nothing remarkable. Wassermann negative.

The patient was sent to a hospital and as she then seemed better it was decided to try improving her condition still further before operating. Many diagnoses were considered but the most probable was thought to be partial perforation of a peptic ulcer or acute cholecystitis. An enema resulted in the passage of some feces and gas. The next morning her condition was improved but during the day the symptoms again became aggravated and operation seemed imperative.

**Operation.** August 10. Anæsthetic ether. A stomach tube was passed and about a quart of green black fluid of pea soup consistency and of fecal odor was siphoned out. Six inch median epigastric incision. The stomach was small and injected. Pushing up behind the stomach and most prominent behind the gastrohepatic omentum was a firm, tense tumor, the size of a grapefruit, which felt cystic. A rapid glance at the neighboring organs revealed nothing abnormal. The entrance of intestine into the foramen of Winslow was not observed. Incision was made through the gastrohepatic omentum and there was exposed a smooth, purple black tumor. On opening this there was a gush of about a pint of brown fluid of fecal odor. Two soft rubber tubes were sewed into the opening of the tumor sac for drainage. Further exploration was impossible and the abdomen was closed without the true situation having been demonstrated. A small piece of tissue of the sac wall was removed and later examined microscopically and reported to be gangrenous intestine by Dr. J. H. Wright.

The immediate postoperative recovery was gratifying; the pain was relieved, the patient's condition improved and she soon began to take restricted diet.

Shortly it became apparent that there was a fistula into the small intestine resulting in a constant and profuse discharge of liquid contents with particles of food from the small bowel. Every attempt was made to build up the patient's condition in order to make possible a second operation but without avail. The temperature was never high, the respirations averaged about 20 but the pulse was always rapid and of poor quality. She gradually sank and died 31 days after operation.

**Postmortem.** This was only partial and done under some difficulty after the body had been embalmed. A long incision was made from the pubes to the ensiform to the left of the middle line. The stomach, transverse colon and greater omentum were identified and pulled up; these were essentially normal. The junction of the duodenum and jejunum was easily found. The jejunum was followed up and after a very short distance was found to turn upward and disappear in the foramen of Winslow. The distance from the beginning to the point of disappearance was 120 centimeters. Coming out of the foramen of Winslow was another loop of collapsed small intestine which was followed down and at a distance of 90 centimeters was found to join the cecum. This meant that all of the small intestine except the 120 centimeters of the jejunum and the last 90 centimeters of the ileum had been contained in the hernia. The lesser omental cavity was then broken into above the stomach and found to contain a mass of necrotic soft tissue, part of which was evidently bowel wall. The right side of the abdominal wall extending downward from the operation wound was undermined between the peritoneum and the muscle by infection, making a large cavity. The liver appeared normal and nothing remarkable was observed in the pelvis. No organs were removed. (We marveled that the patient had lived so long with only a little over a meter of the jejunum left as an avenue of

fluid and nourishment to the body. Furthermore it seemed that had it not been for the exhaustion from the large septic cavity, the patient might have lived longer and even improved sufficiently to warrant a second operation. Still had this been possible, probably the only procedure would have been to do an anastomosis between the loops of the small intestine proximal and distal to the hernia. Likely with so little bowel left, the outcome in a short time would have been the same.)

**Past history.** (The family history was not important and the past history is purposely placed here after the present illness.) There were no acute diseases in childhood, and no history of sore throats, rheumatism or chorea. She had had gripe twice 17 years ago, had always been nervous and 18 years ago had had a nervous breakdown. Two children were living and well, aged 10 and 15 years. Preceding these was one of premature birth. Menstruation was not abnormal. In 1914, an abdominal operation had been performed said to have been appendectomy, right salpingo-oophorectomy and ventral suspension. Habits: Ate slowly, tea and coffee rarely, no alcohol, constipated, used senna and figs.

When a young woman, the patient began to have periods after meals, of uncomfortable feeling in the stomach. These reappeared without apparent reason, sometimes after a remission of many months. As time went on, the attacks became more distressing, were of longer duration and accompanied by soreness in the upper abdomen. There was no nausea and no vomiting. She learned at these times that liquid food gave least distress and often for weeks she could eat no solid food. In the fall of 1917 she consulted Dr. E. B. Freeman of Baltimore, had an examination by X-ray and was treated in St. Agnes Hospital where she was kept in bed 3 weeks and was given a careful diet. Since then the old symptoms continued, with increasing frequency, to recur but had no relation as far as the patient could observe to diet exertion or physical rest. Late this spring while taking a liquid diet for this stomach trouble she lost 20 pounds in weight, her usual weight being 115 pounds. Afterward while eating solid food after the stomach trouble had gone, she gradually gained 6 pounds, had a good appetite and was comfortable until the present attack.

Dr. Freeman has allowed us to use here the valuable notes from the record of the patient obtained by him on October 5, 1917.

**Present illness.** Digestive symptoms began 10 years ago with fullness and pressure in the upper abdomen. These symptoms would occur periodically, and usually last a few days to a few weeks, not to return again for several months. In the past 6 months the fullness and pressure have been constant and the patient has noticed a great deal of abdominal soreness. There are, however, no severe attacks of pain, no nausea or vomiting. Appetite is always good. Bowels are habitually constipated. Present weight 110 pounds, former weight 115 pounds.

**Physical examination** shows a rather small woman, anemic in appearance. Pupils are active and equal. Extraocular movements are normal. No exophthalmos. No tenderness over accessory sinuses. No discharge from ears. No general glandular enlargement. Isthmus of thyroid palpable. Teeth are in good condition, a number have been filled. Throat normal in appearance. Lungs apparently clear throughout to auscultation and percussion. Heart normal in size. Sounds clear at base and apex. Blood pressure 120/70. Pulse between 50 and 60. Abdominal examination: wide costal angle, soft abdominal muscles. Definite cecal stasis without tenderness. Sigmoid is easily felt and is spastic. Right kidney freely movable. Liver, spleen and left kidney are not palpable. Deep reflexes are normal.

**Stomach analysis.** Fasting stomach. Empty after the usual rice retention meal. Test breakfast: 25 cubic centimeters free hydrochloric acid, 20 degrees, total acidity 30 degrees.

**Fluoroscopic examination** (10, 7, 17). Stomach is two finger breadths below the crest, in good position. Normal peristalsis and motility. Stomach and cyp normal in outline. There is definite cecal stasis. First portion of the transverse colon is up and to ward the left, in the prepyloric region. (Our italics.) At this point the transverse colon dips down into the true pelvis. Splenic flexure in good position. Impression. Second degree splinchnoptosis with adhesions in the right upper quadrant of the abdomen.

Our patient's clinical history, compared with the records of similar cases, is exceptional because none of the 33 cases previously published gives an account of symptoms extending over so long a time, and the case has been of particular interest to us because, in a period of 17 years or more, there has been a repetition of attacks of fullness and pressure in the upper abdomen lasting for days or weeks, with remission of symptoms for months. This was indication, we believe, of spontaneous reduction and recurrent formation of a hernia through the foramen of Winslow without symptoms of intestinal obstruction. The X-ray examination made by Dr. Freeman, 7 years before, showed that the first portion of the transverse colon was pushed or held up in the prepyloric region, and, in view of all the data now obtained in the case, we think this is some evidence of, at least consistent with, the presence of a hernia in the foramen of Winslow at that time.

There are other instances of these hernias existing without intestinal obstruction and, like wise of their spontaneous reduction.

We learn from Neve's (19) report that spontaneous reduction of a hernia through the foramen of Winslow may happen, for, even though he was unable to remove much of the gut from the hiatus at the time of the laparotomy, later, recovery took place—the first to occur following laparotomy. (We presume that, later, the reduction of the hernia was completed, because it was stated there was "recovery"—unless the hernia persisted without symptoms.) Also, in Neve's case, there was only partial intestinal obstruction. That there may be no evidence of obstruction in these hernias is set forth in Picado's (20) case in which there was only epigastric swelling—which the mother attributed to sudden accumulation of fat—for 12 days before the breaking out of "alarming symptoms." The only complaints during this period were discomfort, weight, and "lazy digestion." Then, again, the first case recorded—that of Blandin (3) in 1824—was one in which no obstruction of the bowel was found in the hernia through the foramen of Winslow. Only

when the herniated bowel had formed a second hernia was there strangulation at the point of rupture in the transverse mesocolon where it had forced its way from the small into the large abdominal cavity. A double hernia was what took place in Treves (31) patient the first recorded operation on a patient with a hernia through the foramen of Winslow but in this instance there was obstruction of the bowel at the foramen of Winslow and with this further difference that the second hernia was formed by the cæcum and appendix which forced a way out of the lesser peritoneal cavity through the gastrohepatic omentum and lay on the anterior surface of the stomach. This was like the case of Copenhaver (5) already stated. A second hernia had almost formed in our patient—a tense cystic tumor behind the stomach was bulging up and about to push through the gastrohepatic omentum.

### SYMPTOMS

The symptoms, in the absence of definite intestinal obstruction are epigastric discomfort, weight swelling fullness and pressure and fullness and pressure were the frequently recurring complaints in the long history of our patient. Likewise, in Picado's (20) patient, there was 'swelling for 12 days before alarming symptoms appeared.' So if we could establish a diagnosis of hernia through the foramen of Winslow, the absence of pain would indicate that there was no definite obstruction. This group of symptoms at least some of them are also coexistent with the pain in obstruction, and it was so with our patient.

*Pain* is always present with hernia through the foramen of Winslow when accompanied by intestinal obstruction. The pain is usually located in the epigastrium or right upper quadrant or in both areas as exemplified in our case. Again, the abdominal pain may be quite general as stated in Ullman's (3) case in which 4 inches of the lower ileum formed the hernia. Morton (18) found the pain in the central and lower abdomen and the lower ileum was herniated while Majoli (15) reports the pain was in the 'lumbar' and abdominal regions the transverse colon making the hernia. In the remarkable account by Radovan (21) the 'torturing pain' was situated in the right iliac fossa and the great mass of bowel found at operation in the lesser peritoneal sac consisted of a large portion of the transverse and all of the ascending colon, cæcum, appendix, and part of the ileum which had gone through the foramen of Winslow. This patient recovered! Further the pain may be intermittent, paroxysmal or almost constant. The writers think after studying all

the literature that the location of the pain helps little in determining the portion of the bowel in the hernia, but that pain does suggest intestinal obstruction and we know, too, that if the hernia causes pulling or tension on the mesentery, it would produce pain.

*Vomiting* often projectile in character is the most constant symptom after pain but it seems not to occur as a result of these hernias where there is no intestinal obstruction. Our history shows no vomiting until it occurred with an acute attack of epigastric pain followed by disappearance of all symptoms for 2 weeks. The writers are convinced these hernias may disappear and recur and conjecture that in this instance, the act of vomiting caused a temporary reduction of the herniated bowel. But when thereafter vomiting presented itself and pain and distress would disappear for hours the relief was probably dependent upon removal of distention from the stomach and jejunum. Treves (31) however, states that vomiting gave his patient no relief. Vomiting is frequently mentioned in the histories—by Elliot Square (29) Picado (20) R. Stecchi (30) Morton (18) and others. The appearance and odor of the vomitus however are seldom mentioned, and this sparsity of detail in various other ways relating to the patient and the symptoms leaves an incomplete picture in the majority of the histories. Such an omission as not to state the character of the vomitus however may be unavoidable since all physicians know how often patients or the attendants are unable to describe its color, odor, quantity, or consistency.

Therefore we are able in these respects to sift little data of value from the histories before us.

Carwardine (4) says that his patient an engineer aged 44 while telephoning was seized with a severe colic which doubled him up, and while he was not at first 'sick' had slight nausea, later was 'sick' several times and two days from onset, brought to the Infirmary black vomitus 'black as ink' and it was wondered if he had not swallowed ink. He was operated upon at once and the herniated bowel was found to be black and lustreless, as in our case. As stated in our report a quart of green black fluid was removed from the patient's stomach just before operation. It was fecal in odor and as thick as the usual pea soup. In Carwardine's (4) history was the first mention we found of any of the characteristics of the vomitus. After intestinal obstruction has taken place, we suppose it is not known when the vomitus first becomes 'fecal' or fecal, and the time might so vary in different cases that it would have little value as diagnostic data. Fæcal vomitus is always

proof of obstruction Majoli (15) says that his patient—a man 44 years old—first suffered profuse sweating, and that this was followed in half an hour by sharp abdominal pains, which were relieved by eructation of “foetid” gas. We all know that vomiting brings ease to a distended stomach, and we have noted that vomiting often relieves pain in obstruction of the intestine, doubtless because the tension of the bowel has been removed by regurgitation of its contents into the stomach. In our patient, after vomiting there was rest from severe pain and other symptoms for 2 weeks before her last attack. Vomiting, in this instance, may have temporarily reduced the hernia. In the final attack of our patient, there was always a period of relief after vomiting.

We assume that the “profuse sweating,” stated to have occurred in Majoli’s patient a half hour before the appearance of pain, was in great part a shock symptom resulting from the drag on the mesentery, though this should ordinarily have caused pain.

*Constipation* is often mentioned in connection with hernias through the foramen of Winslow. In Elliot Square’s (29) patient there was no action of the bowels for 4 days after the onset of the symptoms. Failure to obtain benefit from enemas or cathartics is often stated. Purgatives, when administered, seemed always to increase the pain and other symptoms—and there could be no other effect! Besides, we know that repeated cleansing enemata may not remove all fecal masses from the upper part of the large bowel, which may remain there for many days. Only recently we observed this in a case of acute obstruction of the lower ileum in which the cæcum and ascending colon remained filled with large inspissated masses of feces—unusually dry because there had been much vomiting and, as a result of dehydration of the tissues, the system had drawn eagerly upon all available fluid in the body. Repeated enemas had returned without feces, yet when the obstructive band was cut during an operation, gas and fluid were pressed easily into the colon and around these masses. So, we think that in this affection, and intestinal obstruction generally, the knowledge whether the bowels move or do not would contribute little to the diagnosis, because the bowel below the obstruction may not be emptied of fecal matter for days after intestinal stoppage when the patient might pass feces. Our patient had “what seemed like a natural bowel movement,” accompanied by vomiting, 4 days after the beginning of the last acute attack, and she was then fairly comfortable for 12 hours. Such an occurrence is perplexing when we are thinking

of acute intestinal obstruction, and we must remember to discount the negative evidence of bowel movements.

*Posture* is sometimes mentioned in the records. At the onset of an attack of pain, our patient would often take the knee chest position, which she thought made the pain less intolerable; at other times she lay on her back, with the legs flexed, though sometimes extended. Majoli’s patient had less pain in the sitting posture, Elliot Square’s patient was doubled up with the pain, or when easier, sat up by the fire, while Treves’ patient insisted on getting up, walking down stairs, and remained in a sitting posture because he could not lie down.

The facies of the patient is seldom mentioned. Majoli observes that the eyes are cloudy and sunken and the skin yellow, and Ullman says the patient’s eyes were sunken and the “face pinched and haggard, skin clammy, very toxic.” Jeanbrau and Riche speak of the facies as “drawn”, our patient looked weary, had sunken eyes, and a dry, brown coated tongue—one of the evidences of the dry tissues—and she complained of thirst, and Picado also mentions a dry, coated tongue, and thirst.

Distention, fullness, or swelling of the epigastrium or upper abdomen is generally noted, if an examination is made. Our patient, when seen on the fifth day of acute symptoms, exhibited epigastric fullness and tension extending toward the right, and this area felt tense. Tenseness and resistance is the description of Carwardine and Engstadt, while Ullman adds “marked resistance.” Reynier, as quoted by Jeanbrau and Riche, seemed much impressed with the flattening of iliac fossæ in contrast with the prominence in the epigastric and hypogastric regions, and the latter authors make a similar observation. We think this appearance of the abdomen, when present, would be a valuable diagnostic sign of hernias through the foramen of Winslow.

We noticed a spherical mass in the epigastrium, and after emptying the stomach by the stomach tube, we could feel a very definite tumor of a grapefruit size, and the percussion note over it was dull both before and after this procedure. Treves’ patient presented dullness for the first time on the seventh day. In Corry’s case, the entire abdomen was tympanitic. In this respect, the findings vary, depending, of course, upon the fullness or emptiness of the stomach, and whether it contains air or gas, and we suppose, also, that the tumor sac may sometimes contain gas. The occurrence of an epigastric tumor in these hernias is probably usual. A tumor was observed by

Majoli Picado, Jeanbrau and Riche, Sinclair, Kaddour and Engstadt

Epigastric or upper abdominal tenderness is doubtless always present though it may be hardly evident even though there be marked muscular resistance as we note in Ullman's case. We found tenderness over both the epigastric and gall bladder regions. Copenhagen detected tenderness only over the gall bladder area, while Morton found the abdomen only slightly tender just to the right and below the umbilicus.

The temperature, pulse and respiration are not generally recorded in the literature but in our patient, these seemed not affected in proportion to the extent of the condition found within the abdomen. Up to the time of the operation, the respiration and pulse—except during a paroxysm of pain—varied little from normal and there was little departure from normal in the temperature. These facts taken with the generally fair condition of the patient, appeared incompatible with the finding of a large mass of necrotic bowel on opening the abdomen and it caused us great surprise. We recall that most patients present the appearance of being very sick following acute obstruction of the bowel as from twists and bands. Perhaps the obstruction developed slowly here and in some way may have allowed the system to adjust itself to the influx of poison. In Elliot Square's patient there was a rapid pulse and high temperature; in Engstadt's the pulse was 36, the heart beats 90 and temperature 103; in Picado's a labored respiration, fever, and faint pulse; and in Jeanbrau and Riche's there was apyrexia. There was no uniformity found probably because of the varying complexities in the different patients.

No intestinal peristalsis was observed in our patient before operation but after this while the dressings were being changed peristaltic waves were sometimes seen over the left middle abdomen followed in a few moments by expulsion of contents from the abdominal opening leading to the herniated sac. Also, in the records of these hernias we noticed only three references to intestinal peristalsis and these to the effect that it was absent. Morton says there was intestinal "splashing" but no distended coils seen and Ullman and Copenhagen found no evidence of peristalsis. We think this absence of waves may be due often to the amount of intestines drawn into the lesser abdominal sac.

**Blood.** In our patient the hæmoglobin was 80 per cent and the white count 15,800. In Ullman's patient with about the same duration of symptoms, the white count was 16,400.

The literature gives no information bearing on a direct cause of hernias through the foramen of Winslow. Treves' patient was seized with epigastric pain 3 hours after a heavy meal; in Delkeskamp's patient the epigastric pain developed immediately after normal labor; in Morton's case pain came after defæcation; in Sinclair's after a spell of coughing; in Engstadt's patient after lifting a heavy weight; in Carwardine's the pain came on while the patient was telephoning. In our patient no such incident was obtained from the history and this agrees with a number of the histories given though it should be especially noted that the pain almost always epigastric, usually occurs suddenly.

We believe that a correct pre-operative diagnosis of hernia through the foramen of Winslow can be made. We think that we could be able to diagnose another case. The general opinion is that if we recognize intestinal obstruction it is the essential point. We should, of course, be able to do more than that. Surely it is helpful for the surgeon to have a fairly clear idea of what he is to treat when he enters the abdomen. In approaching a diagnosis of acute cases we give what we consider the important symptoms in their order: (1) acute epigastric pain, (2) tumefaction or definite tumor in this region, (3) obstipation, (4) repeated attacks of vomiting with temporary relief and the usual general symptoms of intestinal obstruction. The previous history would rarely help as ours is the first published case suggesting recurrent attacks.

#### TREATMENT

The *sine qua non* is, of course, the early recognition of the fact that a surgical emergency is present even though it be impossible to make a correct diagnosis.

In the cases recorded in the literature the operative procedure has been as follows:

1. Reduction by simple traction. This was accomplished very easily in 1 case easily in 4 with some difficulty in 1 and was found to be impossible in the others. Traction may always be tried but it should be borne in mind that the pull must be very gentle and it may be assisted by pressure over the herniated bowel above the stomach.

2. Reduction by traction after finger dilatation of the foramen of Winslow. This was accomplished in 2 cases but is seldom possible.

3. Reduction by pressure from above, and taxis, after evacuation of the herniated bowel through a trocar. In 2 cases this method sufficed to restore the bowel to the greater peritoneal cavity.

The fact that reduction was possible in the above cases does not, however, mean that the patients all lived, because the mortality was very high.

Enlargement of the foramen of Winslow may be undertaken only with the greatest care, because of the danger of injury to the common duct, hepatic artery, portal vein, and vena cava. The following method of *debridement* of the foramen suggested by Jeanbrau and Riche is translated from their article (14).

"An incision is made on the first portion of the duodenum, parallel to it, through the peritoneum which forms the anterior layer of the lesser omentum. After this it is possible to push down the first portion of the duodenum, while the peritoneal leaf is lifted upward, exposing the vessels, and one then sees a space between the common duct and the portal vein, the bottom of which is formed by the posterior peritoneal layer of the lesser omentum, which extends backward to be reflected off the vena cava. Then, holding the common duct out of the way with the thumb and index finger, and protecting the vena cava with this finger, the operator makes a hole in the posterior layer of the lesser omentum close to the duct and between it and the portal vein, thus a vertical buttonhole is formed, parallel to the duct, and large enough to admit the finger. By gentle traction, the left border of this buttonhole, containing the hepatic artery and portal vein, is drawn to the left. Then the operator, with the left index finger still in the foramen, protecting the vena cava, inserts the right index finger into the buttonhole already made. Working his finger along toward the back, he easily enlarges the buttonhole, also breaking through the floor of the foramen, thanks to the laxity of the tissues behind the duodenum. Then light traction suffices to draw out the herniated bowel—at least if there are no adhesions, and there usually are none." They say further "We have done this several times on the cadaver. In each case, we were able to determine that a foramen, which would normally admit only the index finger, would, after *debridement*, admit two or even three fingers." For a more detailed account of the procedure, reference should be made to their article.

The general principles of treatment would be obvious at once to any surgeon, and can be summarized briefly as follows:

1 This is a surgical emergency and early diagnosis must be made. 2 Immediate exploration is preceded by gastric lavage. 3 Gentle traction is assisted by gentle pressure from above. 4 If this fails, the distended loops are evacuated by

means of a trocar, the opening in the bowel closed and traction is tried again. 5 If reduction is still impossible, a temporary ileostomy or jejunostomy may be made in one of the herniated loops, with the hope of tiding the patient over the crisis, and of being able to do more at a later date. Also, a lateral anastomosis between loops above and below the obstruction should be considered. The procedure must be adjusted to the individual case. 6 *Debridement* of the foramen of Winslow may also be considered.

This case of hernia through the foramen of Winslow is presented especially for these reasons because it is a rare condition, that it is the second case to prove that these hernias may form without acute symptoms (Picado's case was the first), because it suggests, as indicated by our patient's history, that such hernias may be reduced spontaneously and recur many times, and for the reason that it adds proof to other case reports that a hernia through this opening may exist without obstruction of the bowel.

We should not forget this condition when considering affections of the upper abdomen, and should remember that the first signs of its presence are sudden swelling or protuberance of the epigastrium coincident with the onset of the symptoms of pain and distress. It is important, finally, that the surgeon, when exploring the upper abdomen for an obscure surgical lesion, should include the examination of the foramen of Winslow.

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## A TECHNIQUE FOR THE REPAIR OF LARGE VESICOVAGINAL FISTULÆ<sup>1</sup>

BAC A ROEDER MD FACS OMAHA NEBRASKA

VERY little has been added to the principles of the operation designed by Marion Sims in 1852 for vesicovaginal fistulæ. In most instances Sims' principles with Emmet's technique suffice for the fistula about 2 centimeters or less in diameter. Before vaginal and total abdominal hysterectomies were practiced as extensively as they are at present the average vesicovaginal fistula measured about 1 to 1½

centimeters in diameter and was generally caused by prolonged labor. Surgical procedures through the vault of the vagina such as total hysterectomies are occasionally followed by vesicovaginal fistulæ from 1 to 4 centimeters in diameter.

These fistulæ are due either to a direct injury of the bladder wall or to an interference with the blood supply of this particular area in the bladder. It is not uncommon to note that leakage of urine through the vagina does not occur until 4 to 10 days have passed following a total hysterectomy. This naturally suggests that necrosis of a limited area of the vaginal and bladder walls occurred finally allowing a flow of urine into the vagina.

The interference with the blood supply of the lower ureter and bladder following total hysterectomies as a cause of postoperative ureteral and bladder fistulæ is a point deserving of more consideration than it has received in the past. The blood supply of the inner portion of the anterior vaginal wall and the apposed bladder comes from branches which originate from the inferior vesical and uterine arteries. The uterine arteries send branches to surround the vault of the vagina, the anterior branches uniting to form a single vessel which runs forward in the midline of the anterior vaginal wall. This is known as the arteria azygos vaginæ. It receives a few branches from the inferior vesicles. Figure 1 clearly shows that a total hysterectomy may block the blood supply to the anterior vaginal and apposed bladder walls. This same operation may also block the blood supply to the lower ureters which comes from the uterine artery. In one instance during a total abdominal hysterectomy with both ureters carefully exposed to avoid their injury a ureteral fistula developed 5

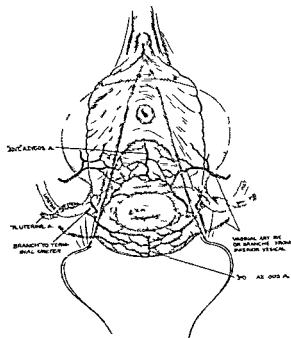


FIG. 1. Blood supply of the vaginal vault apposed bladder and terminal ureters. The usual variation of arterial distribution can occur here leaving this area more scantily supplied than the composite drawing depicted here.

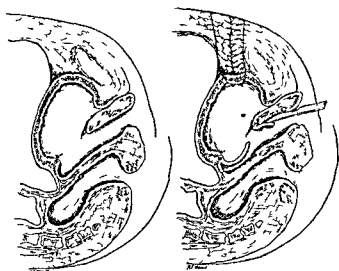


Fig 2

Fig 3

Fig 2 Large vesicovaginal fistula. The illustration does not show the broad ligaments adhered to the bladder following total hysterectomy.

Fig 3 The bladder has been opened suprapubically and the vaginal walls surrounding the fistula have been dissected free from underlying structures.

Fig 4 The first stitch uniting the vaginal walls is used as a traction suture being drawn through the suprapubic opening. A portion of the vaginal mucosa has now become bladder mucosa.

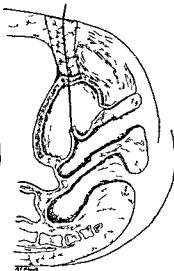


Fig 4

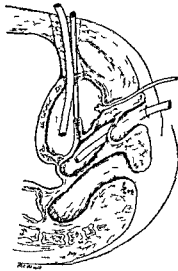


Fig 5

Fig 5 The vaginal flaps have been further sutured and drawn upward by the first suture, which is finally fastened under moderate tension to a glass rod lying across the suprapubic wound. The edges of the remaining vaginal walls are sutured together and a rubber drain is placed into the dissected area and brought to the surface outside the vaginal wall. The suprapubic drainage tube and retention catheter are inserted to prevent urine from accumulating in the bladder and to prevent the possible leakage of urine through the vagina.

days after the operation. I feel positive that this fistula came from shutting off the blood supply. This can also happen during vaginal hysterectomies.

I have had referred to me by surgeons who had previously performed vaginal hysterectomies under considerable difficulties 2 cases of large fistulae of the bladder. These fistulae were about 4 or 5 centimeters in diameter, and were located just posterior to the trigone, possibly taking in the posterior portion of it. So much bladder tissue was destroyed that it would have been impossible for me, through the vagina, to have approximated the edges without tension even after an extensive dissection. In the first instance, I attempted a dissection in order to liberate the bladder, but without success. I repaired these fistulae with the following technique so successfully that I am prompted to make this report.

An incision in the vaginal walls is carried through their entire thickness, starting an inch or more away from the fistula. The vaginal walls are then dissected up to within a quarter of the margin of the fistula. Thick flaps are necessary for an ample blood supply. These flaps are united in several layers with chromic catgut, the first suture being pulled through the previously performed suprapubic cystostomy and

kept under slight tension to assist in coaptation of the vaginal flaps. The bladder should be left open above for drainage, and a self retaining catheter placed in the urethra. In the area remaining after the vaginal flaps have been turned into the bladder, a drainage tube is placed and brought to the surface paravaginally. This is done to prevent a possible leakage of urine through the vagina and the re establishment of the vesicovaginal fistula.

The aftercare is extremely important. The urethral catheter should be irrigated twice daily, the irrigation being allowed to come through the suprapubic tube or wound. The drain inserted paravaginally should be left in at least 10 days in order to drain urine which may possibly leak through the flaps in the bladder.

The history of the operation for vesicovaginal fistula up to 1912 has been very interestingly written by Howard A. Kelly.<sup>1</sup> C. H. Mayo describes an operation quite similar for the small vesicovaginal fistula. The vaginal flap, which he inverts into the bladder, is used for traction only to assist in coapting the outside bladder walls for suturing. The operation I am describing differs from Dr. Mayo's in that the vaginal walls are reflected to become bladder walls. Traction on

<sup>1</sup>Tr. Am. Gynec. Soc. 1912.

<sup>2</sup>Ann. Surg. 1916 12:111, 106.

the larger vaginal flaps does tend to coapt the bladder walls but the flaps cannot be brought together as in the operation for the small vesicovaginal fistulae

#### CASE REPORTS

**CASE 1** The patient age 47 had given birth to 3 children. Vaginal hysterectomy had been performed by another surgeon for prolapse of a subinvolved uterus. Five days following the operation urine was noticed coming through the vagina. For the first 4 days following the operation the bladder apparently held all the urine secreted by the kidneys. Ten days after the operation the vagina was examined and a large vesicovaginal fistula was found. After consultation I advised waiting a month in order that better circulation might be established in the tissues around the fistula.

Two months from the time of operation I repaired the fistula by reflecting the vaginal flaps into the bladder. This operation was performed 8 years ago and the patient has remained perfectly well.

**CASE 2** The patient 50 years of age had given birth to 4 children and had had 2 miscarriages. In March 1906 a vaginal hysterectomy had been performed elsewhere by a surgeon of marked ability. The bladder after

the operation apparently held all of the urine and no signs of a vesicovaginal fistula appeared until the seventh postoperative day.

I attempted a repair of this fistula which was about 5 centimeters in diameter 2 weeks after the operation and met with a complete failure. I attempted a mobilization of the bladder and vaginal walls which could not be accomplished sufficiently for closing this large opening.

Two months after the hysterectomy I opened the abdomen and closed the fistula operating through the peritoneal cavity. The results were apparently perfect for about 1 month when the upper anterior wall of the vagina and the apposed portion of the bladder seemed to slough away with a recurrence of the fistula.

After waiting 4 weeks for an increase in circulation in the tissues surrounding the fistula I repaired the fistula by the technique illustrated. For about 10 days the results were good. The patient then complained of a sudden severe pain beneath the sternum and in the lumbar region. The heart action rapidly increased and death occurred 36 hours after onset of pain. An autopsy by an experienced pathologist disclosed nothing but chronic nephritis and chronic hepatitis. The bladder was so very firmly united in the previous area of repair that it appeared without doubt that the results from the operation would have been permanent.

LOCAL ANÆSTHESIA IN GYNECOLOGY AND OBSTETRICS<sup>1</sup>

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WHILE, in general surgery, extensive use is being made of local anæsthesia, gynecologists seem to have ignored, to a large extent, the possibilities of this form of analgesia, notwithstanding the work of Reclus (14) in France, Schleich (17) and Braun (2), in Germany, Hertzler (8) and Allen (1), in this country, and other authoritative writers. When, in 1913, I (7) advocated local anæsthesia for certain gynecological and obstetrical procedures, a flicker of interest was evinced here and there, but a search through the American literature of the last 10 years has brought to light but a small number of pertinent publications. Yet, continued experience has only served to confirm the correctness of my former attitude, and has even entitled me to enlarge the scope of local anæsthesia considerably beyond my original proposal.

Of the various methods of local anæsthesia, I have tried the blocking of the pudic nerve, as first recommended by Ilmer (9) and Seilheum (18), but gave it up as unreliable, though it is but fair to state that, more recently, King (11) expressed himself as satisfied with it. The parascral anæsthesia which Braun (2) advocates highly, and the transsacral method which Meeker and his associates (12, 13) practice extensively, efficacious though they undoubtedly are, seem to me rather too complicated for general use and so I have adhered to local infiltration anæsthesia, as recommended by me 13 years ago.

It is the latter form with which this paper will deal exclusively.

## LOCAL ANÆSTHESIA IN GYNECOLOGY

In gynecology, it is best suited for certain vaginal operations. The necessary premise for successful anæsthesia is a satisfactory "twilight sleep."

The latter is needed for two reasons. It is required, first, to allay the very natural apprehensiveness of the patient. In this, local anæsthesia does not differ from any other method of rendering an operation painless, whether it be an inhalation narcosis or a spinal anæsthesia. The second, and even more cogent, reason for a preliminary morphine-hyoscine seminarcosis is the imperative necessity of rendering the unnatural position of the patient bearable. Our operating tables have been designed by general surgeons

primarily for general surgical operations. The attachment, at the lower end, for vaginal operations is, as it were, an afterthought. In the exaggerated lithotomy position required for such operations, the physiological lordosis is forcibly straightened out, which results in a severe strain of the sacro iliac synchondroses, and the suspension of the patient's feet on upright leg holders leads to an excessive stretching of the hip joints. Similar unnatural postures were used in the middle ages, and later, in order to inflict punishment or to extort confessions, and few were the unhappy individuals who could withstand the excruciating torture.

In our vaginal operations, we mitigate somewhat this postural pain by supporting the lumbar spine by means of a sand bag, and by raising the leg holders as high as possible, but even this is but a sorry makeshift, and the patient cannot maintain her place more than a few minutes, if her perception of pain were not clouded by a preliminary "twilight sleep."

Our preparations are quite simple. The patient, having secured a good night's sleep by a dose of veronal, receives, 2 hours before operation, a hypodermic injection of morphine grain  $\frac{3}{8}$  with 1 cubic centimeter of hyoscine (grain  $\frac{1}{135}$ ). Her eyes are covered and the ears plugged with cotton soaked in oil. The room is darkened and all noise averted. Family members are not admitted. If, at the end of one hour, pulse and respiration are normal, another injection of morphine grain  $\frac{3}{8}$  with  $\frac{1}{4}$  cubic centimeter of hyoscine (grain  $\frac{1}{270}$ ) is given. If pulse or respiration have slowed down only  $\frac{1}{2}$  cubic centimeter of hyoscine is used, and the second injection may be omitted altogether if pulse and respiration seem excessively slow. If, on the contrary, the patient exhibits, after one hour, signs of marked idiosyncrasy in the form of restlessness or hallucinations, the second injection is, likewise, omitted, such a patient is definitely unsuited for local anæsthesia.

The sleeping patient is gently lifted on a stretch-er, conveyed to the operating room placed in the desired position and cleansed in the usual manner, with this exception that alcoholic or otherwise irritating disinfectants, such as ethereal soap, picric acid solution, or tincture of iodine are not used.

<sup>1</sup> Read at a joint meeting of the Chicago and St. Louis Gynecological Societies held in Chicago December 4, 1926.

The standard fluid for the local anæsthesia itself is a  $\frac{1}{2}$  per cent solution of novocain with adrenalin 3 drops to the ounce

The first group of operations to be considered comprises curettage amputation of the cervix or other plastic operations thereon and vaginal hysterectomy

The technique of anæsthesia is the same in all these procedures The cervix is exposed grasped with a tenaculum in either lip and *gently* pulled down and to one side Into the lateral fornix thus unfolded the needle of the syringe is inserted alongside of and close to the cervix to a depth of one inch The direction of the point of the needle therefore is a trifle lateral A resistance encountered indicates that the needle has entered the wall of the cervix the needle must then be pulled back a little and reinserted It requires but very little experience to know when the needle is in its proper place in the soft tissue of the parametrium Ten cubic centimeters of the solution are now injected *while the needle is slowly withdrawn* The procedure is next repeated on the other side For major operations such as hysterectomy a slightly larger quantity (15 to 20 cubic centimeters) is injected on either side By this infiltration of the parametria the large sympathetic ganglion of Frankenhauser near the upper end of the cervix is effectively blocked

After the two injections it is essential to wait from 3 to 5 minutes until the blanching of the vaginal portion indicates that anæsthesia is accomplished If the vaginal portion is not discolored completely a few cubic centimeters may be injected into the space between cervix and bladder and cervix and rectum respectively

Two possible dangers may easily be prevented The needle may enter a blood vessel and the fluid be thrown into the circulation direct The result might be a collapse Braun (2) has collected a number of such accidents the symptoms in every case were alarming but lasted only a short time and left no permanent effect behind The complication can be avoided by testing through pull on the piston whether the needle has perforated a vein, and by injecting slowly and always with the needle in motion

Another danger may arise from the breaking off of the needle Steel needles rust easily and break off at the hilt It is therefore important that the needle should not be inserted its full length so that if it should break off it can be extracted without difficulty

I am pleased to say that I have not yet encountered either of these two undesirable complications

As to the operations themselves curettage under local anæsthesia presents no difficulties The most painful step of this operation is dilatation particularly if the internal os is narrow and rigid Under local anæsthesia this part of the operation is entirely free from pain and I have the distinct impression that the resistance of the internal os is less than under general narcosis

Amputation of the cervix under local anæsthesia is not only completely painless, but is definitely easier than under inhalation narcosis because there is none of the free bleeding which usually, is such a disturbing and time consuming factor The healing differs in no wise from the ordinary course

I have performed 6 vaginal hysterectomies under local anæsthesia, most of these on elderly obese shortnecked women of the type which is not popular with anesthetists The indication was cancer of the body in 4 cases and prolapse in 2 In these operations too the blood sparing effect of the local anæsthesia was a very pleasant feature which obviated the usual continuous sponging The method used was the two stitch operation designed by Dickinson (4)

Cutting through the parametria was entirely painless but after this act of the operation was completed the pull on the infundibulopelvic ligaments caused a definite pain of which the patient seemed to be conscious even though the perception was dulled by the preliminary twilight sleep Fortunately, this pull is of very short duration as the adnexa are quickly removed and the pain can be greatly reduced by the *steady and gentle* traction of an intelligent assistant An additional injection into the upper part of the broad ligaments at this moment appeared to have little effect It seems entirely permissible to tide the patient over this short duration of sensitivity by a whiff or two of gas or ethylene or a few drops of ether and I may say in this connection that I do not consider a local anæsthesia imperfect because at a certain step in any operation, a general anæsthetic has been used to aid the analgesic properties of the local injections To give the patient this minimum and harmless quantity of inhalation narcosis is merely humane and distinguishes the procedure from the riding of a hobby

The final step of the hysterectomy that is the closure of the peritoneal cavity the uniting of the stumps of the broad ligaments and their interposition between bladder and vagina was, again painless in all 6 cases Ruge (16) suggested in 1912, rendering the entire vulvar circumference anæsthetic in all major operations so as to elimi-

nate the pressure pain of retractors, etc. This proposition which is also recommended by Farr (5) seems eminently sound to me.

Anterior colporrhaphies require injections into the layer between vagina and bladder. Only a very small quantity of the solution is needed because the sensibility of the tissues is very slight.

Perineorrhaphies, on the other hand, demand a copious infiltration. The initial injection is made at the lower end of one labium minus. From this point, the needle is thrust along the mucocutaneous border as far as the other labium minus, and the solution is freely injected while the needle is being slowly withdrawn, or else, wheal after wheal is formed, as the needle progresses from one lip to the other. Tenacula can now be placed on either end of the anesthetized area and traction exerted. The tissues between vagina and rectum are next infiltrated well beyond the extent of the proposed denudation. Finally, 5 or more cubic centimeters are deposited, by deeper puncture, into the levator on either side. If, during the operation, some perception of pain is still evidenced, an additional injection will quickly produce analgesia.

I have approached perineorrhaphies under local anesthesia only hesitatingly. Influenced, no doubt, by my reading, I feared the inconvenience and time consuming technique of local anesthesia, the oedematization of the tissues which would render their differentiation difficult, and the interference with wound healing. Practical experience, however, has convinced me that none of these objections is valid. The injections take but a very few minutes' time, the oedema is not noticeable because a good deal of the fluid escapes as soon as the denudation is made, and the bloodlessness of the tissues makes their proper separation even easier than usual, and, finally, wound healing is not disturbed in any case by the preceding local anesthesia. In particular it is not necessary to draw the sutures "more tightly so that the tissues are still held in apposition after the fluid is absorbed" (8). In fact, I believe that unsatisfactory results of wound healing in perineorrhaphies are entirely independent of any anesthetic and are caused by too tight suturing and too thick cutgut which resists absorption too long.

Of other gynecological operations under local anesthesia, I have closed one vesicovaginal fistula (1) and performed vulvectomy for kraurosis in 2 cases.

The Le Fort operation for total prolapse was carried out twice under local anesthesia. In the last 3 cases of this kind, however, I found that the

twilight sleep alone sufficed to render the operation on the overstretched and insensible tissues painless.

Local anesthesia was, further, used in the repair of third degree tear and in the interposition operation, in the latter there may be a brief sensation of pain when the uterus is luxated into the wound.

Of minor procedures, operations on the urinary meatus, removal of Bartholinian cysts, and enlarging of a tight perineum were satisfactorily carried out under local anesthesia.

I have found local anesthesia of particular advantage in cases in which extensive vaginal repairs had to be combined with abdominal procedures. The list of proposed operations in such a case usually reads like this: curettage, amputation of cervix, perineorrhaphy, hæmorrhoidectomy, laparotomy for shortening of round ligaments and appendectomy. None of these operations is serious, none requires much time, but their total consumes much time and necessitates a very long inhalation narcosis. In such cases, I nowadays perform all the vaginal work under local anesthesia and do not commence the ether or gas narcosis until the position of the patient has been changed and the latter has been prepared for the laparotomy.

#### LOCAL ANÆSTHESIA IN OBSTETRICS

In the realm of obstetrics, local anesthesia has been used in abdominal cesarean sections for years. Webster's (22) first operation of this kind took place as early as 1909. Traugott (20) published a series of 12 cases in 1914. The abdominal incision is rendered painless either by infiltrating the abdominal walls in successive layers along the line of the proposed incision or by injecting into the tissues around the incision in the form of an ellipse. The uterus itself possesses no sensibility and may be incised and emptied of its contents without causing discomfort, but any pull or pressure on the parietal peritoneum produces more or less intense pain. It follows, then, that any method in which the uterus is left *in situ*, is better suited for local anesthesia than the "classical" cesarean section with eversion of the organ, and since the cervical cesarean section is constantly gaining in favor among progressive obstetricians, a promising field is being opened for local anesthesia. For it can hardly be denied that, by local anesthesia, both mothers and children would be protected from the very obvious disadvantages and dangers of an inhalation narcosis which, beyond a doubt, has been the cause of many a preventable death. Furthermore, local anesthesia obviates the customary haste in

closing the uterine incision which may result in imperfect adaptation and consecutive weakening of the uterine wound

I myself did not adopt local anæsthesia for this kind of work until comparatively recently and as occasions for cesarean section are not overly numerous have thus far used it in only 2 cases. The analgesic effect was not altogether flawless but I ascribe this to lack of technical skill which, with growing practical experience should improve. In particular I failed to anæsthetize the parietal peritoneum sufficiently but the results obtained by De Lee (3) Irving (10) Trout (21) Ross (15) and by Frey (6) to mention but one of the continental writers leave no doubt as to the perfect feasibility of the method.

Of other obstetrical operations curettage for incomplete abortion or vaginal anterior hysterotomy in the early months of pregnancy are very easily and painlessly performed under local anæsthesia. In these cases parametric infiltration at the base of the broad ligaments is employed.

It was to be expected that local anæsthesia was also tried in normal childbirth to allay the pain of the second stage. The first attempts go back to the eighties when soon after the discovery of cocaine a solution of this drug was applied to the vaginal and vulvar mucosa (Stassny 19). Today this method is only of historical interest.

For some time I have been using local anæsthesia systematically in normal labors principally of primiparous women. At the end of the second stage when the head first becomes visible during the contractions the perineal body and the levator muscles are injected in exactly the same manner as has been described above for perineorhaphies. The analgesic effect is very striking and is particularly impressive in those cases in which the vulvar ring is narrow and has not become softened by the physiological succulence and oedema of the tissues. Within a few minutes after the infiltration the behavior of the patients undergoes a marked change. They still groan during each contraction and indicate the lower back as the seat of pressure but their loud complaints and piercing cries when the pelvic floor is forcibly being stretched cease.

One can well observe that the pain of parturition is composed of two factors: the pressure upon the sacral nerves and the tearing of the resisting or clonically contracted fibers of the pelvic floor. The former is decidedly the lesser of the two and is rendered quite endurable by the fading effect of the 'twilight sleep' injections which the patient had received some time during the first stage. The second component factor is influenced

by the local anæsthesia. The levators and the muscles of the perineum relax the vulvar ring yields and gapes widely and the child's head passes easily and painlessly through the vaginal opening without the aid of ether which heretofore, we have always given during the second stage.

On several occasions I have thus applied low forceps—twice even when deep transverse arrest necessitated rotation—without requiring any ether. In emotional women who bore pain badly the spectacle of comparative comfort and return to the interrupted 'twilight sleep' was certainly impressive.

*Then too the number and extent of perineal lacerations was distinctly reduced in the patients delivered with local anæsthesia.* There was one tear of third degree when a child of 9¼ pounds with persistent occipitoposterior position had to be rotated with forceps but in the great majority of cases there were no lacerations at all or only very superficial rents in the vaginal mucosa behind the uninjured fourchette which neither bled nor caused pain when repaired after the birth of the child. The original tightness of the vulvar circumference however was attested in several cases by shallow breaks of the mucosa near the vestibule. It may therefore be profitable to surround the entire vulva with a ring of infiltration. Episiotomies can of course be made and repaired equally easily and painlessly.

Local anæsthesia exerts no influence on the uterine contractions, nor have I seen any ill effects in the sense of later necrosis or infection. The procedure is extremely simple and at the same time convincingly efficacious and is equally applicable in hospital and home deliveries.

I may add here that for many years I have likewise performed circumcisions under local anæsthesia. In these young infants that are still under the obstetrician's care only novocain is used without addition of adrenalin and the space between the two leaves of the prepuce is liberally infiltrated by means of a hypodermic syringe. This renders the cutting off and sewing of the foreskin painless but the breaking of adhesions to the glans is not affected by the anæsthesia.

#### SUMMARY AND CONCLUSIONS

The immense broadening out of the field of surgical anæsthesia which is taking place under our very eyes owes its principal impulse not to a mere desire for innovation but to the realization that there are dangers in anæsthesia which we must try to reduce to a minimum. That local anæsthesia fulfills this desideratum to a very great

extent is long past discussion. That it is not ideally perfect in all respects, may be argued with equal justice, of any other form of human endeavor.

In gynecology and obstetrics it deserves much more attention than it has heretofore received. Certain vaginal operations are particularly well suited for local anæsthesia. Curettage, plastic operations upon the cervix, and vaginal hysterectomy can be rendered painless by infiltrating the base of the broad ligaments with a novocain-adrenalin solution. Colporrhaphies, perineorrhaphies, and a number of other operations require diffuse infiltration of the tissues themselves with the same solution. In every case, a morphine-hyoscine seminarcois should precede the local anæsthesia.

In obstetrics, abdominal cesarean section may successfully be performed under local anæsthesia. This applies in particular to cervical cesarean section. Curettage for abortion and anterior hysterectomy are surprisingly easy when attempted under local anæsthesia.

The employment of local anæsthesia in normal parturition opens a new and promising field for the relief of the excruciating pain of the second stage.

The indications for local anæsthesia are the contra-indications to inhalation narcosis, such as pulmonary tuberculosis, diffuse bronchitis, emphysema in elderly women, heart lesions, arteriosclerosis, and the like.

There are no real contra-indications to local anæsthesia, but there are limitations. A restless patient with an idiosyncrasy against hyoscine is not a suitable subject. If many peritoneal adhesions are likely to be encountered, it would be useless to insist on local anæsthesia. In other words, local anæsthesia should never become a mechanical routine any more than any other form of surgical anæsthesia should ever be the one and

only method employed. But with this principle of individualization firmly in our minds, we shall find that in a fairly large percentage of our operative cases, local anæsthesia will best safeguard all the interests of our patients.

NOTE.—Since the foregoing was written, I have performed several cesarean sections in local anæsthesia and with complete freedom from pain, even though in one instance the preliminary injection of morphine and hyoscine was purposely omitted. In addition, a fairly large number of all the various vaginal operations which were mentioned in the body of this paper have been carried out in local anæsthesia, and the experiences of the last 6 months have in every way, confirmed the observations and conclusions here presented.

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## THE RATIONAL TREATMENT OF TUBAL DISEASE

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IT is not an exaggeration to say that the paper which F. T. Simpson read before the American Gynecological Society in 1909, "The Choice of Time for Operation for Pelvic Inflammation of Tubal Origin," was epoch making in the annals of gynecology. The mortality for this condition, under the old plan of immediate operation, had ranged as high as 20 per cent, but Simpson was able to report for the new principle of delayed operation a series of 456 cases with a death rate of 1 per cent, which was for that time an unparalleled record. His dicta: absolute recovery from the acute attack, a consistently normal temperature for at least 3 weeks, even after thorough bimanual examination, and the complete absorption of the inflammatory exudate surrounding the primary focus of infection, were at first regarded as Utopian and ultra conservative, but their logic has gradually won them general acceptance, with the result that the prognosis in tubal disease today is decidedly different from what it was a quarter of a century ago.

To physicians who began to practice in the era when immediate operation for acute salpingitis was the rule, the recent literature advocating a return to that plan, long considered happily defunct, is most disturbing. Superficially the results seem good and the arguments seem convincing, but closer investigation at once makes it apparent that the logic is unsound and the reasoning meretricious. It was with the idea of proving once more the better results of conservative treatment of tubal disease that I began to study the most recent operative records of Charity Hospital and of Toussaint Infirmary in New Orleans, and although the last 300 consecutive cases from each institution very definitely proved my point, I must admit frankly that the figures astonished me.

It had been my opinion, formed from my own practice and from casual observation of the practice of others, that the principles of Simpson were carried out, at least in a modified form, on all of the gynecological services in both institutions, and it was surprising, therefore, to discover that in 292 cases, very nearly half of the total number of 600, operation was done in the presence of fever ranging from 99 to 104, while in 89 other cases the temperature had been normal less than a week. That is, in 381 cases, very nearly two thirds of the total number studied, the criteria upon which

the delayed operation is based were frankly disregarded. The immediate results in these cases, as compared with the results in the cases in which the deferred operation was done, are extremely interesting in the light of the claims which are generally advanced by the advocates of immediate surgery.

It might be well to state at the outset that the champions of the deferred operation base their position on three cardinal points: first, that salpingitis is essentially an infectious disease with the gonococcus responsible for the greatest number of cases, and that autosterilization by natural processes is the rule in at least 70 per cent, provided sufficient time is permitted for this outcome to occur; second, that the pathology of salpingitis is various and spontaneous clinical recovery may ensue in any type of the disease, although naturally it is most frequent in the milder types; third, that involvement of the general peritoneal cavity is most exceptional, and death during an acute attack is equally unusual for which reasons the deferred operation carries practically no additional risk to the patient.

Bearing these criteria in mind, then, let us examine the composite arguments for the immediate operation as they are set forth in the literature.

1. "It is nothing more than common sense that any destructive process should be arrested at the earliest possible moment. With this incontrovertible statement the advocates of both methods will heartily agree, although they differ radically as to how the happy result may best be achieved. Our claim that the process may be more safely left alone than entrusted to surgery is established by the fact that studies of literally thousands of cases have shown that almost invariably these patients show prompt clinical improvement when once the proper rest treatment is instituted and that a permanent normal temperature is reached within a week or 10 days in some 70 per cent of all cases. Moreover, as is the rule in any disease of bacterial origin the patient, if let alone, will develop her own immunity, a point proven conclusively by the laboratory studies of Andrews, Curtis, Menge and others, all of which show that the percentage of negative cultures increases in direct ratio to the length of time the case has been cooled. Finally, we need

scarcely point out that the apparent paradox of allowing a debilitating disease to run its course is obviously more logical than abdominal section in the presence of live bacteria when by a period of waiting exactly the same procedure may be carried out minus this tremendous source of danger

2 "Granting that active infection is present, its spread is of no more consequence than in operations for appendicitis, indeed less so, since the organisms are usually less virulent." Such a facile dismissal of the dangers of infection within the peritoneal cavity can only be dictated by poor surgical judgment. We have no choice but to interfere in acute appendicitis, delay spells disaster. If a high mortality rate followed expectant treatment and deferred operation in acute salpingitis, this particular argument might have to be respected, but since the contrary is true, why run the chance of spreading an infection, even though it be a mild one? Why risk converting a localized process into a general one? The spilling of infected material within the peritoneal cavity must always be a serious matter, and more than once I have seen septicæmia follow even a gonococcal infection

3 "Early operation is even more important in salpingitis than in appendicitis, since no one ever wished to conserve an appendix, good or bad, while the conservation of a woman's genital organs is a matter of vital moment to her health and happiness." Granting the argument, the cases are hardly parallel. We have already pointed out that a deferred operation in appendicitis may be fatal, but that the occasional fatality which follows the deferred operation in salpingitis is rarely due to the delayed surgery. Moreover, in appendicitis the operation is done to correct the original pathological condition, while the usual operation for salpingitis is done to correct the results of the original condition, which throws an entirely different light on the question

Granting, for the sake of argument, that the cases are similar, we cannot see that the records of the advocates of early operation show any particular degree of conservatism. For one thing, immediate operation very frequently means unnecessary operation, since a certain percentage of these cases will always recover spontaneously, and abdominal section under such conditions cannot by any process of reasoning be regarded as conservative. In addition, my own experience, which I am sure is paralleled by that of most pelvic surgeons who have lived through the era of immediate operation, is that surgery done for acute salpingitis is almost invariably radical

Since the involvement of the pelvic organs is general and the protective mechanism has not yet been set in order, bilateral salpingectomy must usually be done, and bilateral oophorectomy and hysterectomy are frequently necessary also. In DuBose's report of 255 cases, for instance, in which immediate operation was done, there were 80 hysterectomies, practically a third of the total number, while in our own series of 600, which includes both types of treatment, only 90 were done, a sixth of the total number, and more than two thirds of these were for fibroids, a positive indication under any circumstances

The other procedures which are supposed to be practical if immediate operation is done are all, to my mind, of very doubtful value. Splitting and drainage of the tube is enthusiastically advocated by Bourne, but the best that he himself can say of it, since he can show no physiological results in the small number of cases in which he has employed it, is that it at least does no harm. As to partial salpingectomy, I agree entirely with Polak, who remarks rather caustically that the only thing he has ever seen that particular procedure accomplish is to pave the way for a subsequent ectopic pregnancy

4 "The supposed salpingitis frequently proves to be appendicitis or ectopic pregnancy." Such an argument is specious, for the experienced gynecologist, to whom doubtful cases are presumably referred, can make a differential diagnosis in all but a negligible number. In appendicitis, for instance, the character and location of the pain, the onset and the clinical course of the disease are usually typical, while bimanual examination will practically always establish the diagnosis at once. In tubal gestation also the type of pain and the onset and clinical course of the illness are usually pathognomonic, particularly if there is a history of suspected pregnancy. In addition, Farrar's work on leucocytosis is of real value in doubtful cases, since the fluctuating white count of an ectopic is quite unlike the consistent blood picture in salpingitis. We admit that in the small number of cases in which a differential diagnosis cannot be established between tubal disease and an ovarian cyst with twisted pedicle, exploratory incision is justified, although such a situation very seldom arises

5 "Rupture of pus tubes is a possibility." It is, but so small a one that such instances are reported in the literature as surgical rarities. For my own part, I should far rather take the chance of having a pus tube rupture while I was treating a patient expectantly than of having to invade

her abdomen while an acute infection was present.

6 *Technical difficulties make the deferred operation very tedious and dangerous.* A study of the pathological conditions present in acute salpingitis would seem to indicate that the exact reverse is true for while the process is still active the structures are so vascular, so infiltrated, and so friable that they are injured by even the gentlest manipulations while free oozing often demands drainage a procedure which is always fraught with dangerous potentialities. Under our improved modern technique the enucleation of pus tubes presents no more difficulty to the experienced gynecologist than does any other pelvic surgery while in my opinion the difficulty of managing adhesions in the deferred operation has been emphasized unduly. When the infection is of gonococcal origin a line of cleavage may usually be found promptly, and although the operation may be more trying when pyogenic organisms are involved the danger of invading the peritoneal cavity in the face of an active streptococcal infection more than compensates for the slight additional difficulties encountered later.

7 Postoperative complications are less than in the deferred operation, when fistulae infections and residual abscesses are common. On my colored service at Charity Hospital where the worst types of neglected tubal disease are handled I can recall only one fecal fistula in the last 4 years but I can recall many times that number in the days when I was doing the immediate operation when the infiltrated and friable bowel was torn in more than one place in an endeavor to release fresh adhesions.

I have no figures at hand except those I have compiled myself but it is decidedly significant I think that of the 82 patients in the series of 600 studied who developed postoperative complications of some sort 59 nearly 72 per cent had not been properly cooled. From the standpoint of temperature which is a legitimate index of convalescence the results are similar. Of 285 cases in which the postoperative temperature exceeded 101° a normal febrile reaction after abdominal section, 206 72 per cent were uncooled patients. Of 208 cases in which the temperature elevation lasted more than a week after operation 139 nearly 67 per cent were uncooled. Of the 241 cases discharged with a temperature still above normal, 190 nearly 79 per cent, were uncooled. That is nearly three quarters of all the postoperative troubles in the series developed in patients who were not allowed to recover completely from their original infection. In addition,

while 14 days in hospital is a generous allowance for the usual abdominal case in this series the postoperative stay days averaged 20, while DuBose's stay days for his series of uncooled cases averaged 23.3. Certainly these figures do not seem to bear out the claim that the convalescence is smoother when immediate operation is done.

8 *The mortality is lower when immediate operation is done.* To this statement we take decided exception in spite of such brilliant reports as DuBose's 419 cases with 1 death and Bonney's who claims that in 20 years of radical treatment of acute salpingitis he has lost but 1 patient. In the hands of expert men good results sometimes follow even the violation of all the principles of sound surgery, but we would point out that unfortunately most operations are done not by expert gynecologists but by men who are frequently neither experienced nor expert and it is well therefore to inquire how the practice works out when it is generally applied.

In the series of 600 cases studied from the New Orleans hospitals, 57 surgeons are represented. There were 18 deaths a rate for the entire series of 3 per cent but it is highly significant that 16 of those 18 deaths occurred in cases which were not thoroughly cooled before operation. That is, 2 of the 119 cooled cases died a rate of less than 1 per cent which we might add is the accepted risk for surgery of the tubes but 16 of the 381 uncooled cases were lost, a death rate of 4.2 per cent or rather more than 4 times as high.

During the 10 years from 1916 through 1925, 6,184 cases of salpingitis were treated at Charity Hospital, partly by expectant and partly by radical measures yet the death rate for the composite series in spite of the fact that the majority of these cases were in colored women and that many of them represented the severest types of neglected pathological conditions was only 2.5 per cent a figure which we do not hesitate to assert would have been materially lowered if conservative treatment had been the rule in all instances. Holtz lost only 2 of the 400 patients in his series who were operated on after a thorough cooling of the original process, a death rate of .5 per cent while Ricci in a study of 1,500 cases from the Woman's Hospital reports a mortality rate for the acute cases of 14 per cent, but a rate of less than 1 per cent for the cooled cases. Even a cursory survey of these figures will suffice to show that in discussing mortality rates it is quite as important to examine the mortality of the average operator as the average mortality of the operation.

9 "Chronic invalidism and sterility are usually the result of expectant treatment." The facts by no means bear out this claim. We have pointed out that a certain percentage of these patients will recover spontaneously after a single attack of salpingitis, and that operation under the circumstances would be unnecessary as well as mutilating, but we might add that a woman who recovers clinically under expectant treatment, even though she does not bear children, is certainly no more absolutely sterile than a woman whose tubes were removed at laparotomy during an acute attack. In a study of 1,083 cases recently published by Holtz, whose figures are to be respected because the follow up system of the Scandinavian clinics is probably the best in the world, only expectant treatment was employed, yet 12 per cent of pregnancies ensued and there were 82 per cent of complete cures, while only 2 per cent of the patients thus treated were entirely unrelieved. I know of no series of cases treated by immediate operation which can show such brilliant end results as these.

These, then, are the arguments in favor of immediate operation for tubal disease, as I have gathered them from a survey of the recent literature on the subject. Most of them are specious and practically all of them are controvertible by studies of large series of cases, exactly as they have been by the figures I have quoted to you from the 600 cases I have investigated myself, figures which are certainly more than mere coincidence. The only argument which to my mind has any weight in favor of early operation is that of expediency, since it is frequently impossible to persuade these patients to submit to the necessary periods of rest. In Charity Hospital we have special wards on both the white and the colored services to which such patients are admitted for their infections to cool off, but their ignorance and their social and financial circumstances are frequently such that one is forced to choose between operating before one's better judgment dictates or permitting them to leave the hospital in no better condition than when they entered it. Even with private patients it is not always possible to defer operation as long as one considers it wise, but under no circumstances will I operate upon a patient whose temperature has not been consistently normal for at least 10 days, during which period repeated vaginal examinations have been made.

On my own service the treatment for such cases is routine. Absolute rest in bed during the acute attack and until the temperature has been normal for 10 days or more is the cardinal point

in their management. Pain is relieved by local applications, preferably ice caps, and opiates are resorted to only on urgent indications. The bowels are regulated by mild laxatives and gently given enemata, drastic cathartics may be productive of considerable harm, and I cannot agree with Royster that a daily saline is a wise measure. Fluids are forced, by proctoclysis and hypodermoclysis if necessary, and all possible supportive measures are invoked. Hot vaginal douches are given if they add to the patient's comfort, but they are not routine. The course of the disease is checked by bimanual examinations at regular intervals, particular attention being paid to the temperature fluctuations thereafter, and white counts are also made regularly.

Under this treatment possibly 15 per cent of all cases of salpingitis will achieve a permanent spontaneous cure. It has long been realized that this was a possibility when pyogenic organisms were responsible for the original infection, and Curtis has recently reported similarly good results from purely expectant treatment in gonorrheal tubal disease provided the patient can be kept isolated from the original source of infection. In another group of cases, possibly 10 per cent, the type we see most often on our public services and particularly among colored women, the pathological changes are so extensive that operation is indicated as soon as the case has cooled. Unfortunately, too, because of original neglect and unwise management, radical surgery must usually be done, bilateral salpingectomy was necessary in 243 of the 300 cases studied at Charity Hospital, and unilateral or bilateral oophorectomy was necessary in 218. Between these two extremes, however, lie the great majority of cases, and it is here that the decision must be made on the individual merits of the case. In all instances our aim should be to defer surgery as long as possible, and it is surprising how often cases which were apparently hopeless achieve at least a clinical recovery spontaneously.

When surgery must be done, its extent should be based not only upon the pathological condition present, but upon the age and social condition of the patient, and to a certain extent upon her own desires. Financial considerations naturally cannot be ignored, in our public institutions at least, when conservative surgery might mean the possibility of a second operation.

In general, when the process is tuberculous, both tubes must be removed, and the same procedure is wisest when the infection is clearly of specific origin. Otherwise, greater conservatism is possible, and sometimes the mere release of

adhesions is all that is necessary. Unless the uterus is directly implicated in the infectious process which is not usual, or is myomatous or otherwise diseased or is so denuded during operation that a useless organ would be left in situ, its removal is not indicated. In short, hysterectomy should be done on intrinsic indications, and not because extra uterine disease happens to be present.

Every effort should be made to save ovarian tissue. Frequently in these cases we have to deal with an ovary which is diseased not essentially but because it has been in bad company, and its conservation is always indicated if it seems likely that extirpation of the primary focus of infection will relieve its acquired condition. Oophorectomy however is definitely indicated when the ovary is directly involved in the infectious process when it is riddled with cysts, or when its blood supply has been damaged. In doubtful cases ovarian transplantation is to be preferred to resection if the aim is to avoid symptoms of a

precipitate menopause in young women, but its field is limited.

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# EDITORIALS

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## SURGERY, GYNECOLOGY AND OBSTETRICS

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### "CULT AND OCCULT"

UNLESS a person is deeply interested in a search for truth in a special field, it is better for him to keep an open mind and, with "a decent respect for the opinions of mankind," to travel with the majority, that his energy may be conserved to develop the work in which he has been trained. If he wishes to devote his life to a study of so called psychic phenomena, it is one thing, but as a side line, investigation of the occult carries distinct danger to integrity of thought. It loosens the mind from the moorings of fact, gives predominance to the lesser senses, and creates emotional disturbances which resemble the instinctive fear reactions of primitive man and the lower animals. One of these reactions was fear in the dark, which remains with us today as a source of emotional disturbance.

Man first recognized only enemies that were large enough to be seen and dangers that could be estimated visually, such as wild beasts, serpents, and tempests. Against phenomena which he could not understand he invoked the protection of his gods.

Through association of ideas, the words *cult* and *occult* have become closely allied. The cultist devotes his energy to the spreading of a special belief not recognized by the majority as resting on a sound foundation. The occultist devotes his time to an attempt to elucidate a belief in hidden and mysterious powers having their origin in a spirit world and to subject them to human control.

Anyone dabbling in the occult, deliberately depriving himself of vision, man's chief means of obtaining information, injures himself mentally. It is a curious ego that in the clear light of reason will prompt one to say of a certain subject, "I do not understand this" and in the dark of suggested psychic influences to say of the same subject, "I believe this is occult," in the sense of a mysterious spirit force. I have known a number of men of great promise in medicine who in the spring time of their lives became interested in a cult or in occultism of the old fashioned spiritualistic type, which led them to unproved or unprovable hypotheses, blind alleys of belief. As a result, they lost their keen perception of fact and made little progress in their profession.

Sir Conan Doyle, in his masterly characterization of Sherlock Holmes, intrigued the interest of hosts of readers and established a school of detective fiction. Sir William Crookes, the last of the great all-around physicists, made investigations which led to the discovery of the cathode ray, the basis of the X ray. Sir Oliver Lodge, who so clearly placed before the interested student the fundamental facts in physics, has the gratitude of all. These are three outstanding men of

science who interested themselves in psychic phenomena and believed in reincarnation of the dead. This interest however came in the autumn of an intense scientific life. Their great days were over. The new interest was a foil to the critical research of the early days like the contemplative philosophy of the Orientals.

There is a divine discontent with the existing order of things which leads to progress. Youth is always insurgent, a builder of images, a dreamer of dreams. When guided by scientific imagination youth builds images to be compared with known facts and dreams true dreams. Age carries mental scars left by experience which contract and shorten vision, but age carries wisdom. Youth and age should travel together, each needs the other for orderly scientific advancement.

The man of 100 years ago who would have attempted to talk about the radio and the wireless would have been regarded as mentally deranged. Had he been able to produce these phenomena they would have been considered occult manifestations from the spirit world, and he probably would have been burned at the stake. Whenever we do not understand existing phenomena let us lay the lack where it belongs to a failure of understanding which the future may clear up, and not allow ourselves to prostitute intelligence by talking about fairies, ghosts, spirits and reincarnation of the dead.

W. J. MAYO

### GASTRIC CARCINOMA IN YOUNG PEOPLE

CARCINOMA of the stomach is attracting widespread attention. Intelligent laymen are asking the question, "At what period of life are we immune?" While gastric carcinoma is undoubtedly of exceptional occurrence before the age of 25

years, and its incidence rapidly increases from the thirtieth year on, at no period of life are we immune. Statistical data support this contention. Osler and McCrea's clinical study of 7,000 cases in 1909, and Bernoulli's report of 50 cases in 1907, prove that a diagnosis based to any degree on the tenet of "cancer age" may lead to a fatal issue. Cancer of the stomach has been found in infants only a few weeks old.

It is difficult to make any statement as to the relative frequency of the various microscopical forms of gastric cancer as classified and adopted by a number of observers. Mixed or transitional types are very common and would probably be found with even greater frequency on examination of the entire specimen instead of only a single portion of the tumor.

A detailed study of several reported cases shows the characteristic picture of carcinoma of the stomach in young people to be sudden onset, violent and rapid course with persistent febrile temperature, absence of cachexia, and early appearance of metastases. The rendering of an early diagnosis is even more difficult here than in gastric cancer at a later age. There are only three features by which these juvenile cancers differ from those seen in older patients: absence of cachexia, early onset of high temperatures, and early formation of metastases.

A study of the symptoms of cancer of the stomach in the young as compared to those seen in older patients presents no essential differences, although genuine cachexia appears to be less common in the early decades of life. Often merely anemia is found, with an otherwise fairly good nutritional condition. A progressive anemia combined with constant pain may give the physician a clue in an otherwise obscure case. An erroneous impression that a malignant process is impossible at an

early age of life may prevent the diagnosis of carcinoma being rendered. An X ray study and the proper use of gastric catheterization are important diagnostic aids, for timely recognition and removal of the cancer are especially important, in view of the tendency to a remarkably rapid course. Prolonged duration is the exception. Surgical interference proves inefficient when it comes too late for radical removal of the primary growth and prevention of metastases. The future will have to show if the onset of malignant disease can be discovered by improved serological methods.

Surgical interference is indicated in all cases in which the removal of the tumor and its immediate metastases seems to be possible. Operative treatment also should be given when the neoplasm has led to stricture of the cardiac or pyloric orifice of the stomach. It will be found that an exploratory operation is called for in most cases, unless there are contraindications against surgical interfer-

ence, due to the general condition of the patient or to the behavior of the malignant tumor itself.

Much publicity has been given to non-operative methods of treatment. Results from irradiation by X rays or radium have not been encouraging and their use is applicable only as a last resort. Though serum therapy is claimed occasionally to have exerted a beneficial action, its results are neither uniform nor reliable. Purely medical care of a case is of necessity limited to the treatment of symptoms, especially pain and starvation.

A study of the subject leads to the following conclusions. Gastric carcinoma in young people should be considered more often, the sudden onset, rapid course with persistent febrile temperature and progressive anæmia without cachexia in a young person complaining of gastric distress and pain should raise the suspicion of carcinoma, surgical treatment should not only be early, but as radical as possible. RAYMOND P. SULLIVAN, M.D.



# MEMOIRS

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## MEMOIR—CHARLES HOWARD PECK

Born June 18 1860—Died March 28 1927

IT is with a sense of deepest personal loss not unminged with sorrow that I record the passing of Dr Charles Howard Peck master surgeon earnest patriot distinguished teacher benefactor of mankind and my friend An association of twenty years begun in the formative youthful days of our earliest professional efforts and ripening into closest companionship closed when he answered the final summons March 28 1927

Such intimate acquaintance afforded abundant opportunities to observe and admire a many sided character beautiful in its simple faith strong in its devotion to study unyielding in its adherence to principle superb in its fidelity to friends and professional contemporaries A brilliant full and varied career, brought to an untimely close at the height of its productiveness cut down at the full tide of its usefulness emphasizes how much service may be crowded into an all too brief period of existence Few gave more than he in the short span of fifty six years allotted to him, few accomplished so much in their chosen walk of life and of few may it be more truly said, that those who knew him best loved him best

Appreciation is measured in superlative terms by friends but in this instance deservedly so as is evidenced by the manifold tributes and expressions of sorrow among companions acquaintances and people of all walks of life Of his many admirable qualities the kindness, charity, and benevolence of his friendship endeared him most, I think The supreme happiness which he enjoyed in the companionship of his professional associates and their confidence and appreciation of his talents signify the high plane of ideals which governed his every action Quiet, kindly cheerful without malice zealous in any cause he espoused earnest in the execution of his duties, he moved among his fellows an example and inspiration to all

His unselfishness and self sacrificing intent is nowhere better illustrated than by his distinguished war record Actively engaged in teaching and busy with a large private practice his patriotism prompted him to join the colors immediately upon the admission of the United States into the World War and he served with credit and distinction throughout its course in France, receiving merited



*Charles H Trebb*



decorations from his own and foreign governments. Commissioned a Major at the outbreak of war, Dr Peck organized and directed Base Hospital No 15, which early arrived in France and was stationed at Chaumont from July, 1917, to July, 1919. During this time he served first as senior consultant in surgery in the American Expeditionary Forces, and in August, 1918, he was transferred to the Surgeon General's office in Washington, D C, as a chief in the department of general surgery, where he remained on duty until his honorable discharge from service with the rank of Colonel, February 4, 1919. He was awarded the Distinguished Service Medal of the U S A, March 26, 1919, the French government made him an *Officier de l'Instruction Publique*, French Republic, and for services rendered during the second battle of the Chemin des Dames, October, 1917, he was quoted in orders "for service rendered to the French Army" and he was made an honorary member of the 68th Battalion Alpine Chasseurs. A son, Charles Howard Peck, Jr, made the supreme sacrifice in France, serving in his father's unit.

No less distinguished was Dr Peck's career as surgeon and teacher. Graduating at the early age of twenty-two years, in 1892, at the head of his class, from the College of Physicians and Surgeons, Columbia University, he served three years in the New York Hospital, engaging in private practice after this, with appointments first as assistant to the Hudson Street Hospital, New York, for two years (1895-1897), attending surgeon to the French Hospital (1897-1899), then on the surgical staff of the Roosevelt Hospital January 1, 1904, serving through the various grades until the date of his death. He was actively engaged in the teaching of surgery in his Alma Mater from 1900 until the time of his death, he had been professor of clinical surgery since 1910. Numerous other hospital appointments fell to his lot, among them consulting surgeon to the Ruptured and Crippled, New York City, to the White Plains Hospital and Nyack Hospital, New York, to the Vassar Brothers Hospital, Poughkeepsie, New York, and to the Greenwich and Stamford Hospitals, Connecticut.

As a surgeon, he was resourceful, meticulous, noted for kindness to tissue and scrupulous hæmostasis, skillful in operative maneuvers, and possessed of a mature judgment, the fruit of long and ripe experience.

Honored by membership in many surgical societies, he served as president of the Society of Clinical Surgery, treasurer of the American Surgical Association and member of its council from 1915 until the time of his death, fellow of the American College of Surgeons and member of its Board of Regents, president of the New York Surgical Society, vice president of the New York Academy of Medicine, member of the American Medical Association and chairman of the section on surgery, 1915, member of the New York County Medical Society, and president, 1919, member of the New York State Medical Society, member of the International Surgical Association, and others.

While not a prolific writer, Dr Peck's contributions to surgical literature were marked by their evidence of thorough study and extensive experience, by their concern of problems of deep interest at the time of their publication and by a scholarly diction, clearly expressed, and definite and worth while viewpoints. His interests covered the broad field of general surgery with a grasp and knowledge which compelled his recognition as a leader of his chosen profession.

CHARLES H. MAYO M.D.



*Novum Lumen Chirurgicum*

OR, A  
NEW LIGHT  
OF  
CHIRURGERY.

Wherein is Discovered, a much more  
Safe and Speedy way of Curing  
WOUNDS, than hath hereto-  
fore been usually Practiced.

*Illustrated with several Experiments made  
this Year in Flanders.*

Authore

JOHAN COLBATCH, Med

L O N D O N,

Printed for D Brown, at the Bible and  
Swan without Temple-Bar, 1695

*Novum Lumen Chirurgicum  
Vindicatum.*

OR, THE  
NEW LIGHT  
OF  
CHIRURGERY  
VINDICATED

From the many unjust Aspersions of  
some unknown Calumniators  
With the Addition of some few  
Experiments made this Winter in  
England

By Jo Colbatch, *Physitian*

L O N D O N

Printed for D Brown, at the Bible and  
Swan without Temple Bar 1695

# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

By ALFRED BROWN, M.D., F.A.C.S. OMAHA, NEBRASKA

### JOHAN COLBATCH'S NEW LIGHT ON SURGERY

QUACKERY and charlatanism ever present though they are in all lines of endeavor, seem nevertheless to have singled out medicine as the object of their greatest attack. The fact that the structure and functions of the human body lie in a realm unexplored by the average layman lends to them an element of mystery which leads, even among the intelligent, to a credulity which in any other field of activity would be looked on as insane. This has gradually bred in the medical mind a defense reaction which shows itself as suspicion in its mildest, and disbelief, if not total disregard of any thing new, in its more developed form. Though this defense reaction has led to delay in the acceptance of many of the great discoveries in medical science, still it has been a saving grace, for innumerable ideas, evolved from thin air and unproven from the standpoint of experiment or clinical fact have fallen by the wayside without ever having had the opportunity to do any definite harm. This has led to the unwritten dictum that before any idea, especially in the therapeutic side of medicine, can gain a foothold the fundamentals upon which it is based must be published freely and the entire story laid openly before the profession as a whole. From time to time attempts to commercialize a discovery in medicine have been made but without success. The reason for this failure is self evident, for the promulgator of a new idea who chooses a method of promotion contrary to the standards of his profession is generally of such low grade that the product of his endeavor is worthless.

On the other hand there are examples in medicine and surgery of men who in the beginning of their careers, classed with the unintelligent if not with the charlatans, have by constant and unflinching effort forced the regular profession to recognize their work as sound and finally to accept them into the fold. Johan Colbatch belonged in this class. He was not a graduate physician but an English apothecary who believed he had discovered an infallible remedy for healing wounds, which was made up of two parts, a so called vulnerary powder and a tincture to be taken internally. He explains the origin of his idea as follows: "Having for a long time been much dissatisfied with the common methods of Chirurgeons in the cure of Recent Wounds, and almost every day, observing the inconveniences that

attend those People who had occasion to make use of them therefore for my own satisfaction, and Mankind's good, I took into Consideration, whether their Methods were agreeable to Reason, and the subject upon which they wrought. At last I was fully satisfied that their Practice was most unreasonable, which I shall endeavor to evince, with as much brevity and accuracy, as the unsettledness of my present condition will admit of. Which when I have done I shall lay down my own Hypothesis, which I doubt not to confirm both by Reason and matter of fact which is the most clear sort of demonstration." Apparently having made up his mind that surgical results were not all they should be he began to concoct various medicines to answer his hypothetical requirements of proper physiological action. He was then ready to test them out and did so by animal experimentations for in his introduction to the reader he says: "Having at length lighted upon a pair of medicines, the one Internal and the other External, which I supposed would answer my Intentions, I began to make Experiments upon Dogs and other Animals. Wounding them in the most desperate manner I could contrive, and in about a Hundred Experiments that I made, I had not above five that miscarried." Then he introduced the usual cry of the individual who, whether rightly or not, believes himself persecuted—"three of which were made before the Right Honourable the Lord Cut's, but two of these three, as I can plainly make appear, after the danger was over, were Poisoned. I was likewise much abused in a Soldier of his Lordship's Regiment, whom after my medicines had set him free from all ill Symptoms, and he almost well in my absence for four or five Hours, (having before for five Days and Nights been constantly with him, for fear of Roguery) was made Drunk, but by whom I know not, and in an hour or two after my return he Dyed." Following these experiments Colbatch made a large supply of his medicines and started on his own initiative for the wars in Flanders, where he was allowed to try his experiments with, according to his statement great success. He was continually at variance with the regular surgeons. But in the end he was elected a member of the College of Physicians and himself became a regular. What his medicines were he does not tell, so his secret died with him and we must form our own judgment as to whether they or his careful washing of the wounds and avoidance of irritants were responsible for his good results.



## REVIEWS OF NEW BOOKS IN SURGERY

AS we speak of a poet's poet so in medicine is there an historian's historian. Sudhoff<sup>1</sup> is best loved and most appreciated by medical historians themselves. He has motivated and directed the study and writing of medical history on a larger and more comprehensive scale than ever before.

That this is so we in America quite generally recognize. But unfortunately that recognition is not based upon knowledge. For but little of Sudhoff has been translated and that little is thinly scattered. His original German—astoundingly difficult, semi-archaic—is only for those well versed in the German idiom or men of abundant leisure. So it is that the common run of us have accepted his greatness as a matter of faith based upon references to him and an intuitive perception of hidden massive genius.

One might misjudge him from reading this book unless one remembers that its essays are selections—mainly by the Master himself—from his shorter and minor papers. Some portions of his greater work are here in an essay on Galen, essays on prehistoric medicine and on the new methods of attack he has developed in prehistoric and mediæval medicine and in epidemiology and hygiene. For an example, he found historical food in Hygienic Directions for Travellers During the Middle Ages. One of his refutations of the theory of American origin of syphilis is here and there is much beside the history of medicine. Garrison's fine sketch of Sudhoff and bits of Sudhoff's related thought—philosophy art letters—and his guiding spirit Goethe.

It is not a book of individuals and individual advances but of points of view, eras, trends, causes and effects and—most of all—stimuli. Almost as often as he solves problems he points out those still awaiting solution. We do miss the excitement of action but in its stead are incited to action.

These essays are minor—but only in relation to the enormous figure of Sudhoff. The very fact that Garrison and a group of men such as Krumbhaar and Ruhrah have effaced themselves in the thankless burden of translation assesses their worth in the field of historiography.

JOHN FALLON

STEVENS MEDICINE<sup>2</sup> appeared first in 1922 and was immediately popular, being reprinted twice in 1922 and again in 1923. It is now entirely revised after an interval of 4 years and is a worthy candidate for the position of a standard student's text. The discussion of various subjects reflects the most recent scientific clinical investigations. The presentation of the subject of diabetes is clear and

forceful. We would be inclined to emphasize some what more the importance of glycaemia levels and the energy value of insulin for the average working diabetic but this is merely a difference in point of view. The Volhard and Fahr classification now so commonly adhered to is presented. It clarifies this complicated subject even if it may not be fundamentally correct. The discussion of hyperthyroidism seems sound.

The presentation is simple and lucid and the text is modern, correct and easily comprehended.

PAUL STARR

IN a publication<sup>3</sup> appearing from time to time in single volumes devoted as the name would suggest to the practical problems of diagnosis and treatment the contributions to the present volume come from the surgical clinic of the University of Leipzig. *Pertoneum* by O. Kleinschmidt.

*Appendicitis* by E. Payr and *External Hernia* by J. Hohlbaum comprise the contents. Payr's contribution deserves special mention. The article in fact is an extensive monograph on the subject of appendicitis. In addition to a discussion of the diagnosis, pathology and treatment of acute appendicitis there is an exhaustive treatise on the attending complications of the disease.

GEORGE HALPERIN

THE variety of subjects discussed by Volkman<sup>4</sup> in his recent book is amazing. In the first part the author covers general surgical preparedness. This includes 23 chapters concerning the arrangement and location of the operating room, asepsis, selection of anaesthesia, haemostasis and other allied subjects. In addition surgical risks are considered, those cases in which the complications are diabetes, acidosis, alkalosis or haemophilia. In this section cases requiring pre-operative roentgen therapy are discussed. Of particular interest are the methods of determining whether the patient's heart will be able to successfully tolerate the surgical shock. The chapter on anaesthesia conveys in general the opinions of H. Braun, excepting that the author favors sacral anaesthesia induced through the sacral hiatus for properly selected cases. Chloroform is used far more extensively there than in America.

The last 80 pages deal with pre-operative care in the treatment of individual organs or in preparation for certain operations. Particularly well developed are the chapters on stomach surgery and prostatectomy.

DIAGNOSTISCHE UND THERAPEUTISCHE INSTRUMENTE UND DEREN VERWENDUNG. Chirurg. by Prof. Dr. J. S. H. 8th of P. to m. by Prof. Dr. O. K. schmidt, Appendicitis by G. H. M. Dr. K. P. Dr. E. Payr. Asepsis by Prof. Dr. J. Hohlbaum. Leipzig: Georg Thieme 1926.

Die Vorbereitung zu chirurgischen Eingriffen. By Dr. Med. J. Volkman. 8th. Julius Sping 1926.

ESSAYS IN THE HISTORY OF MEDICINE. By K. I. S. dh. f. M. D. Translated by v. r. h. ds. ded. ted. w. f. ho. d. and b. g. ph. l. at. ch. by F. l. d. g. l. l. Garrison. M. D. New York: M. D. cal. Lit. Pr. s. 1926.

THE PRACTICE OF MEDICINE. By A. A. Ste. A. M. M. D. ed. ed. e. t. rel. res. Philad. lph. W. B. S. and S. Co. 1926.

This book fills a definite need in medical literature and its only fault lies in its limited length as compared with the magnitude of the subject

SAMUEL J. FOGELSON

IN a monograph<sup>1</sup> of 170 pages on the study of cardiovascular disorders in cases of traumatic arteriovenous aneurisms, the author states that his object is to call attention to the cardiac changes that occur in these cases. The literature barely mentions these changes, the author finding them described in only 27 of 780 cases reviewed.

This work should be of particular interest to those who are devoting much time to surgery of the blood vessels.

A brief history of the subject and a description of the pathological anatomy of traumatic arteriovenous aneurisms are followed by a discussion of the pathological physiology in these cases. The author describes an arteriovenous aneurism as a short circuit in the peripheral circulation which produces a disturbance in the equilibrium that normally exists between the heart, capillaries, tonicity of the arterial walls and the volume of circulating blood.

The circulatory disturbances present in arteriovenous aneurisms, the various views held to account for the cardiac enlargement, and the procedure that should be followed in these cases are each the subject of a chapter. Elimination of the aneurism by any surgical means restores the equilibrium of the factors regulating the circulation of the blood and normal conditions will follow.

A review of the 27 cases reported in which cardiovascular changes were noted is followed by a fairly extensive bibliography on this subject.

R. W. MCNEALY

IN the foreword to the first volume<sup>2</sup> of what is to be an extensive handbook on urology, the editors note the absence of any recent thorough and complete work on urology in the German literature and plan to remedy this defect. We may, therefore, conclude that their work aims to be encyclopedic in character.

Students of urology cannot escape the fact that there are fundamental differences between the German and American schools of urology. In America, urology has proceeded from men who were essentially great surgeons and has taken part in the general surgical advance which has occurred in this country. As a result it has become highly perfected mechanically with little purely scientific development, much of the work in physiology and pathology having been left to internists, physiologists, and pathologists. In Germany a more scientific viewpoint has prevailed and as a result we have seen its

literature enriched with many extensive and valuable contributions from urologists to the physiology and pathology of the urinary system. The physiological point of view has pervaded urological surgery so that discussions of the neuromuscular mechanism of the bladder, for example, are more common than the presentation of methods of removing constrictions of the vesical orifice.

The volume under consideration exemplifies this difference very well. It comprises a number of chapters on the general surgery of the urogenital tract, followed by sections on its pathological physiology, and on the examination of the urine. While the chapters on general surgery include only the more fundamental procedures in the case of each organ, they yet give to the American urologist an impression of being distinctly elementary. A further point that cannot escape consideration is the marked lack of references to work which has been done outside Central Europe. The references to recent American work are extremely few and evidently selected at random since most of the important contributions are omitted. It may be said that American surgeons will find little in these chapters that is new to them with the possible exception of the detailed description of Voelcker's ischio-rectal method of approach to the prostate.

The sections on pathological physiology fall in an entirely different category. They include the pathological physiology of renal secretion, the innervation of the kidney, the normal and pathological physiology of the ureter, the pathological physiology of the bladder, and the pathological physiology of the male sexual organs. Here is a wealth of highly valuable knowledge brought together by authorities and, in contrast to the surgical chapters, documented from the literature of all countries. In the sections on the kidney the distinction between nephritis and the changes produced in the kidney by obstruction, while made, is not insisted upon as strongly as it usually is in American works. Sections on the ureter and bladder are particularly complete and will repay reading by anyone interested in the complicated problems associated with these organs.

The section devoted to the bacteriological, chemical, and microscopic examination of the urine is exceedingly complete from every point of view except that no consideration is given to the extremely interesting modern work (which by the way has emanated largely from Germany) on the colloidal phenomena of the urine.

This work evidently constitutes a great and serious effort on the part of German urologists, and the forthcoming volumes will be awaited with much interest.

DAVID M. DAVIS

A SMALL work by Pierre Pauchet<sup>3</sup> really comes from the Paris clinic of Victor Pauchet, who in writing the preface advises first medical treatment for ulcer, then surgical treatment after

<sup>1</sup>CONTRIBUTION A L'ÉTUDE DES TROUBLES CARDIO-VASCULAIRES DANS LES ANÉVRISMES ARTÉRIO-VEINEUX TRAUMATIQUES. By Dr Édouard Desjardins. Paris: Louis Arnette 1926.

<sup>2</sup>HANDBUCH DER UROLOGIE. ALLGEMEINE UROLOGIE. ERSTER THEIL. CHIRURGISCHE ANATOMIE. PATHOLOGISCHE PHYSIOLOGIE. HANAUER SCIENTIA. Edited by A. von Lichtenberg, F. Voelcker and H. Wildbolz. Berlin: Julius Springer 1926.

<sup>3</sup>LE TRAITEMENT DE L'ULCÈRE DU DUODÉNUM. By Pierre Pauchet. Preface by Victor Pauchet. Paris: Gaston Douin & Cie 1926.

the third attack when it is necessary Anglo Americans are credited with the insistence of differentiation between duodenal ulcer as opposed to stomach ulcer in 1910

Fourteen conclusions at the end of the exposition really cover the author's intention. Among them he says duodenal ulcer is called the most medical ulcer medical treatment should be persisted in under certain conditions for a period of not over one year if there is no improvement. Medical treatment should also be used for those patients unable to withstand operation and as a follow up after operation.

With hæmorrhage hyperacidity prolonged pain, and permanent deformity of the bulb operation promises relief. A patient who suffers pain from digital pressure over the ulcer is menaced by perforation and the ulcer should be resected.

It is advised that the gall bladder and appendix should be inspected during operation and treated if diseased.

If no duodenal ulcer is found on exploration gastroenterostomy should be performed. Gastroenterostomy will not cure all cases of ulcer. Caution of the ulcer is advised when the duodenum is movable and the acidity is low likewise Finney's operation is applicable to the same conditions.

Duodenopylorotomy is excellent for mild acidity and pylorospasm. Gastrectomy is the treatment of choice for high acidity and hæmorrhage. In severe hæmorrhage medical treatment should not be persisted in over 36 hours. Operation is then indicated. Duodenal ulcer complicated by peptic ulcer after enteroanastomosis should be treated by gastrectomy if there is still hyperacidity.

ALLLOGG SPEED

A PICTURE of Mackenzie<sup>1</sup> has been written which is most impressive and inspiring. His start in life at the age of fifteen as an apothecary's assistant and his end as the courageous pioneer in the science of medicine is dramatically presented. It is a devoted and occasionally extravagant eulogy of a great man. It is not meant to be a definitive biography. Mackenzie's development and the source and sequence of his theories are enthusiastically expounded and they are of course most interesting although of almost impossible simplicity. The book makes absorbing and stimulating reading and gives the impression of being a genuine portrait.

PAUL STARR

WHILE there is nothing startling or new presented in Thomson and Gordon's monograph<sup>2</sup> on rheumatic diseases it is a very clear concise exposition of this important subject. The book is very well written and it is easily read. There are no over enthusiastic statements.

THE BELT AND PULLEY. BY SIR JAMES MACKENZIE. By R. Macmillan & Co. New York. The Macmillan Company. 1925.

CHRONIC RHEUMATIC DISEASES. THEIR DIAGNOSIS AND TREATMENT. BY F. G. THOMSON, M.A. (Cantab), M.D. FRCP (Lond), D.R.C. GORDON, M.D. D.Sc. MRCP (Edin). New York Oxford U. Verity Press. 1926.

The chapter on fibrositis is very good. As an illustration of the economic importance of this subject it is stated that two million pounds a year are spent on sick benefits from rheumatic diseases in Great Britain.

The authors believe that heredity and inherited diatheses are important factors. They present a special chapter on climacteric arthritis which they believe is usually of metabolic origin.

All forms of chronic rheumatic diseases are discussed including brachial neuritis lumbago sciatica intercostal neuralgia arthritis of various types and gout. Under the principles of treatment there are discussed drug treatment hydrology, climate physiotherapy orthopedic treatment vaccines and diet.

It is a book that can be safely recommended to everyone interested in arthritis and its numerous allied conditions.

PHILIP LEWIS

A DELIGHTFUL narrative somewhat choppy in spots of the life and time of Adolph Kussmaul<sup>3</sup> appears in a little volume of 131 pages. It is a reprint from the *Annals of Medical History* of June 1926. Those who read Dr Bast's article in the *Annals* will welcome its reissue. The narrative has been rounded out and has been presented in some what better form. The first part is based on Kussmaul's autobiography.

Professor Bast has called attention to an error generally accepted in Germany giving Kussmaul credit for the earliest use of the stomach tube. He quotes Dr Smithies. To the average German physician credit for the stomach tube and its employment goes to Kussmaul. Authority is cited showing the employment of the stomach tube by Alexander Monro in 1797. Later as is shown Philip Syng Physick and his sick's nephew John Syng Dorsey used the stomach tube early in the nineteenth century. One recalls also John Hunter's paper of September 21 1790 in which he describes the employment of a stomach tube for the purpose of feeding a patient unable to swallow the idea occurring to Hunter because of his use of such an instrument in introducing food into the stomachs of experimental animals.

The reader is introduced anew to Kussmaul's accurate clinical observations his versatility as clinician and experimentalist as author and poet. The value of the volume is enhanced with a Kussmaul bibliography.

IRVING S. CUTLER

THE second of the three volumes in a series on anatomy by Deaver<sup>4</sup> treats of the upper extremities neck shoulders back and lower extremities. It continues the excellent presentation of the first volume and the revision and rearrangement make it even more valuable than the favorably

THE LIFE AND TIME OF ADOLPH KUSSMAUL. By Th. de Haes. Ph.D. New York P. B. Hoeber. 1925.

SURGICAL ANATOMY OF THE HUMAN BODY. By J. H. B. D. M.D. Sc.D. LL.D. F.A.C.S. 2d ed. Philadelphia P. Blakiston & Co. 1926.

known original work. In text and elegance of illustration little is left to be desired. This is essentially the standard reference for the advanced student and practicing surgeon. The tyro can profit much from the plates and from descriptions of selected regions but a systematic simpler treatment should serve as his introduction to surgical anatomy. L B A

**VOLUME 11** of *Ergebnisse der medizinischen Strahlenforschung*,<sup>1</sup> like volume 1, consists of a number of exhaustive monographs dealing with various radiotherapeutic or roentgenodiagnostic problems. Each one is admirably presented, consideration being given to practically every phase of the radiological investigation of the subject. Each monograph is in fact a collective review of the literature pertaining to the matter under discussion so combined with personal experience as to form an authoritative, scientific, and practical summary of our present day knowledge of that subject. The book is profusely and well illustrated, and an extensive bibliography is appended to each section. As a reference work, it forms a most valuable contribution to radiological literature.

The topics on diagnosis include ventriculography by Juengling, myelography by Peiper, interlobar

*ERGEBNISSE DER MEDIZINISCHEN STRAHLENFORSCHUNG (ROENTGENDIAGNOSTIK, ROENTGEN RADIUM UND LICHTTHERAPIE)* By H. Höffel, R. Holthausen, O. Juengling, H. Martius. Vol. 11. Leipzig: Georg Thieme 1926.

pleurisy by Fleischner, and duodenal ulcer by Berg. The first two subjects are discussed from the historical, anatomical, physiological, technical, and diagnostic angles and special consideration is given to clinical application, indications, contra indications, and untoward effects. Fleischner emphasizes the need of knowledge of anatomy in the direct and differential diagnosis of interlobar conditions. Berg stresses the direct roentgen findings of duodenal ulcer, he shows how they are related to the pathology, and estimates their clinical value.

An article by Kroetz deals in detail with the effect of short wave radiation upon the acid alkali balance in the body, particularly as regards the reaction in the blood. Geller discusses the results of experimental radiation of the ovary relative to its effects upon the individual cells, the organism as a whole, and upon pregnancy, and correlates them with the practical aspects of radiotherapy of these organs.

Radiotherapy of bronchial asthma is covered by Kiewitz from the standpoint of rationale, technique, and results. Carcinoma of the tongue as treated by roentgen rays and radium is discussed by Schemp as regards pathology, radiosensitivity, effect of various techniques and indications. Scheele presents an article on endovascular electrocoagulation which deals mainly with technique, indications, and results.

ADOLPH HARTUNG

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

*DIAGNOSTIC DES PRINCIPAUX CANCERS* By Henri Hartmann. Paris: Masson et Cie 1927.

*DIE WIRKUNGSWEISE ABGABESTUFEN KEIMDRÜSEN SCHAEDIGUNG EINE EXPERIMENTELLE STUDIE ZUR FRAGE DER ENDOKRINEN SEXUALFUNKTION* By med. Dr. Heinrich Viktor Klein. Berlin and Wien: Urban & Schwarzenberg 1927.

*DIE SCHWANGERSCHAFT AUSSERHALB DER GEBÄRMUTTER (Diagnose und Differentialdiagnose)* By Prof. Dr. Robert Zimmerman. Leipzig: Georg Thieme 1927.

*LES CANCERS DU SEIN* By Pierre Delbet et Mendaro. Paris: Masson et Cie 1927.

*CHIRURGISCHE ROENTGENOLOGIE EIN GRUNDRISS DER ANWENDUNG DER ROENTGENSTRAHLEN IN DER CHIRURGIE MIT EINEM ANHANG RADIUMTHERAPIE* By Dr. Hans Kurtzahn. With a foreword by Prof. Dr. M. Kirschner. Berlin and Wien: Urban & Schwarzenberg 1927.

*HANDBUCH DER BIOLOGISCHEN ARBEITSMETHODEN* By Geh. Med. Rat Prof. Dr. Emil Aberdhalder. Lieferung 2-4. Die gerichtsarztliche Untersuchung des gesunden und kranken Menschen. Berlin: Urban & Schwarzenberg 1927.

*SURGICAL APPLIED ANATOMY* By Sir Frederick Treves. Part 8th ed. rev. by C. C. Choyce. CMG, CBE, BSc (NZ), MD (Edin), FRCS (Eng). Philadelphia and New York: Lea & Febiger, 1927.

*THE PRACTICAL MEDICINE SERIES* comprising eight volumes on the Year's Progress in Medicine and Surgery. Under the general editorial charge of Charles L. Mix. A.M., M.D. Series 1926. Chicago: The Year Book Publishers 1926.

*A TEXTBOOK OF EXODONTIA, EXODONTIA, ORAL SURGERY AND ANESTHESIA* By Leo Winter, DDS. St. Louis: The C. V. Mosby Company 1927.

*THE CONQUEST OF DISEASE* By Thurman B. Rice. A.M., M.D. New York: The Macmillan Company, 1927.

*ÉLÉMENTS D'OBSTÉTRIQUE* By V. Wallich and Ed. Lévy Solal. Paris: Masson et Cie 1927.

*HARELIP AND CLEFT PALATE, CHIELOSCHISIS, URANO SCHISIS AND STAPHYLOSCHISIS. HISTORY, ETIOLOGY, DEVELOPMENT, ANATOMY, PHYSIOLOGY, TYPES, SURGICAL AND NON-SURGICAL TREATMENT AND REPORTED CASES* By Matthew N. Federspiel, BSc, DDS, MD, FACS, F.A.C.D. St. Louis: The C. V. Mosby Company, 1927.

*PRACTICAL CHIROPODY* By E. G. V. Runtung, FISCh. 2d ed. St. Louis: The C. V. Mosby Company, 1927.

*I TUMORI DELLA GIANDOLA CAROTIDEA* By G. Aperlo and F. Rossi. Milan: Dottor Francesco Vallardi, 1927.

METHODS AND PROBLEMS OF MEDICAL EDUCATION 6th Series New York The Pockefeller Foundation 1927

THIS BUSINESS OF OPERATIONS By James Radley Foreword by J M Withrow M D Cincinnati The Digest Publishing Company 1927

INFECTIONS OF THE HAND By Lionel R Fifield F R C S (Eng) New York Paul B Hoeber 1927

KOMPENDIUM DER GEBURTHSHILFE EIN KURZES LEHRBUCH FÜR STUDIERENDE UND ARZTE By Dr Walter Hannes Berlin und Wien Urban & Schwarzenberg 1927

TRABAJOS Y PUBLICACIONES DE LA CLINICA DEL PROFESOR PEDRO ESCUDERO vol II Buenos Aires El Ateneo 1926

CHININUM Scriptioes collectae Amsterdam Bureau for Increasing the Use of Quinine

PRINCIPLES OF PHYSICAL CHEMISTRY FOR MEDICAL STUDENTS By Phyllis M Tookey Kerridge M Sc A I C Introduction by Prof A V Hill M S F R S New York Oxford University Press 1927

APPLIED PHYSIOLOGY By Samson Wright M D M R C P Introduction by Swale Vincent M D LL D D Sc F R S (Ed & Canada) New York Oxford University Press 1926

DISEASES OF THE HEART THEIR DIAGNOSIS PROGNOSIS AND TREATMENT BY MODERN METHODS By Frederick W Price M D F R S (Edin) New York Oxford University Press 1927

ELEMENTS OF HYGIENE AND PUBLIC HEALTH AN INTRODUCTION TO PREVENTIVE MEDICINE FOR STUDENTS AND PRACTITIONERS OF MEDICINE By Charles Porter M D B Sc M R C P (Edin) 2d ed New York Oxford University Press 1926

THE ENLARGED PROSTATE By Kenneth M Walker F R C S M A M B B C New York Oxford University Press 1926

THE MEDICINE MAN BEING THE MEMORIES OF FIFTY YEARS OF MEDICAL PROGRESS By E C Dudley M D LL D New York J H Sears & Company 1927

X RAY DIAGNOSIS A MANUAL FOR SURGEONS PRACTITIONERS AND STUDENTS By J Magnus Pedding F R C S New York William Wood and Company 1927

MANUAL OF MEDICINE By A S Woodward CM G CBE M D F R C P 3d ed New York Oxford University Press 1927

COMPRESSION OF THE LUNG IN THE TREATMENT OF PULMONARY LESIONS By Stuart Tides M D (Lond) M P C P (Lond) New York Oxford University Press 1927

HELIO-THERAPY WITH SPECIAL CONSIDERATION OF SURGICAL TUBERCULOSIS By A Rollier M D Translated by G de Swietochowski M D M R C S New York Oxford University Press 1927

THE TREATMENT OF CHRONIC ARTHRITIS AND RHEUMATISM By H Warren Crowe M D B Ch (Oxon) M R C S L R C P New York Oxford University Press 1926

MANUAL OF OPERATIVE SURGERY By Sir Holburt J Waring M S M B B Sc (Lond) F R C S 6th ed New York Oxford University Press 1927

INDEX AND HANDBOOK OF X RAY THERAPY By Robert Lenk Foreword by Professor Holzkecht Translated by T I Candy M B B Ch D M R E New York Oxford University Press 1926

THE PSYCHO-PATHOLOGY OF TUBERCULOSIS By D G Macleod Munro M D CM M R C P (Edin) New York Oxford University Press 1926

APPLIED REFRACTION By Homer Erastus Smith M D New York William Wood and Company 1927

GYNECOLOGICAL DIAGNOSIS AND PATHOLOGY By A B F Barbour M D LL D F R C P and B P Watson M D F R C S (Edin) F A C S 3d ed reprinted New York William Wood and Company 1927

INTERNATIONAL CLINICS A QUARTERLY OF ILLUSTRATED CLINICAL LECTURES AND ESPECIALLY PREPARED ORIGINAL ARTICLES ON TREATMENT MEDICINE SURGERY ETC Edited by Henry W Cattell A M M D with the collaboration of others vol 1 37th Series 1927 Philadelphia and London J B Lippincott Company 1927

INDIKATIONEN FÜR DIE OPERATIVE BEHANDLUNG DER FRAUENKRANKHEITEN By Dr Walter Benthin Berlin und Wien Urban & Schwarzenberg 1927

A MANUAL OF GYNECOLOGY By John O born Polak M Sc M D F A C S 3d ed rev Philadelphia Lea & Febiger 1927

TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL SOCIETY vol 51 For the year 1926 Edited by Arthur H Curtis M D

LISTER CENTENARY EXHIBITION AT THE WELLCOME HISTORICAL MEDICAL MUSEUM Handbook 1927 London The Wellcome Foundation Ltd 1927

THE WELLCOME HISTORICAL MEDICAL MUSEUM Henry S Wellcome Director London The Wellcome Foundation Ltd 1927

IATHOLOGIE DES MÉNISQUES DU GENOU By Albert Mouchet and Louis Tavernier Paris Masson et Cie 1927

TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION vol xlv Edited by John H Jopson M D

BIBLIOTHEQUE DU CANCER TUMEURS MALIGNES DES OS By G Nové Josseland and L Tavernier Paris Gaston Doin et Cie 1927

BIBLIOTHEQUE DU CANCER CANCER DU NEZ DES FOSSES NASALES DES CAVITÉS ACCESSOIRES ET DU NASO-PHARYNX By Georges Portmann and Henri Retrouvy Paris Gaston Doin et Cie 1927

ANESTHÉSIE RÉGIONALE By Victor Pauchet Paul Sourdat Gaston Labat and R De Butler D Ormont Paris Gaston Doin et Cie 1927

URINARY SURGERY A HANDBOOK FOR THE GENERAL PRACTITIONER By William Knox Irwin M D F R C S E 2d ed rev New York William Wood and Co 1927

PRACTICAL GASTROSCOPY By Jean Rachet M D Authorized translation by Fred F Imantoff D S C B A M R C S New York William Wood and Company 1927

BIOLOGIE UND PATHOLOGIE DES WEIBES By Josef Halban and Ludwig Seitz Lieferung 33 Berlin und Wien Urban & Schwarzenberg 1927

MEDICINE MONOGRAPHS Volume XL—BIRTH INJURIES OF THE CENTRAL NERVOUS SYSTEM CEREBRAL BIRTH INJURIES BY FRANK R FORD CORD BIRTH INJURIES BY BRONSON CROTHERS AND MARIAN C PUTNAM Baltimore The Williams & Wilkins Company 1927

A TEXT BOOK OF MEDICINE By American Authors Edited by Russell L Cecil A B M D Associate Editor for Diseases of the Nervous System Foster Kennedy M D F R S E Philadelphia and London W B Saunders Company 1927

THE INTERNATIONAL MEDICAL ANNUAL A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX 45th year 1927 New York William Wood and Company 1927

BIOLOGIE UND PATHOLOGIE DES WEIBES EIN HANDBUCH DER FRAUENHEILKUNDE UND GEBURTHSHILFE By Joef Halban and Ludwig Seitz vols 31 and 32 Berlin und Wien Urban & Schwarzenberg 1927

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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## PLANS FOR THE 1927 CLINICAL CONGRESS IN DETROIT

PLANS for the Seventeenth Annual Clinical Congress of the American College of Surgeons, to be held in Detroit October 3-7, 1927, are well under way under the leadership of a strong and representative committee of surgeons of Detroit and Ann Arbor. A program of clinics and demonstrations that will adequately represent the clinical activities in the hospitals in Detroit and Ann Arbor and at the medical school of the University at Ann Arbor and the Detroit College of Medicine and Surgery is being prepared and will be published at an early date. All departments of surgery will be represented therein including general surgery, gynecology, obstetrics, orthopedics, urology, and surgery of the eye, ear, nose and throat.

Clinics and demonstrations are being arranged for both morning and afternoon on each of the four days, Tuesday to Friday inclusive, at the following hospitals in Detroit: Children's, Deaconess, Detroit Eye, Ear, Nose and Throat, Detroit General, Henry Ford, Grace, Harper, Highland Park General, Jefferson Clinic and Diagnostic, Herman Kiefer, Michigan Mutual, Providence, St Mary's, and Woman's, and at the University and St Joseph's Hospitals in Ann Arbor. Special plans are being made by the members of the faculty of the medical school at the State University to entertain a large group of visitors each day.

The Executive Committee of the Congress is arranging a special series of clinical demonstrations illustrative of diagnosis, operative and postoperative treatment of surgical conditions, to be conducted by a group of eminent surgeons, including Prof J M Munro Kerr, of Glasgow, Scotland, T de Martel, of Paris, France, William J Mayo, of Rochester, George W Crile, of Cleveland, John B Deaver, of Philadelphia, J M T Finney, of Baltimore, Eugene H Pool, of New York, Barton Cook Hirst, of Philadelphia, John O Polak, of Brooklyn, Frank A Lahey, of Boston, Jabez N Jackson, of Kansas City, George P Muller, of Philadelphia, and others. These clinics will be given in Orchestra Hall where a large attendance can be comfortably accommodated.

Evening meetings on each of the five days of the session are planned. These will be held in Orchestra Hall, a new and beautiful auditorium located on Woodward Avenue not far from the headquarters hotels. At the Presidential Meeting, the first formal session of the Congress, on Monday evening, the president elect, Dr George D Stewart, of New York, will be inaugurated and deliver the annual address. On the same evening the John B Murphy oration in surgery will be delivered by Sir John Bland Sutton of London. The annual convocation of the College will be held on Friday evening when the 1927 class of

candidates for fellowship in the College will be received

General headquarters for the Congress will be established at the Book Cadillac and Statler Hotels both located on Washington Boulevard. At the former hotel will be found the registration and ticket bureaus, bulletin boards, exhibits, etc., while the large public rooms at the latter hotel will be utilized for clinical demonstrations and various scientific meetings.

An application for reduced railway fares on account of the meeting in Detroit is pending with the railways of the United States and Canada, and it is practically assured that a rate of one and one half the regular one way fare for the round trip on the certificate plan will be authorized for this meeting.

#### HOSPITAL CONFERENCE

The annual Hospital Conference will be held on Monday and Tuesday morning and afternoon, the sessions on Monday being in Orchestra Hall and on Tuesday at the Statler Hotel. For Wednesday morning a symposium dealing with the standardization of the ophthalmological and otolaryngological departments in general hospitals is in preparation. The program includes papers, round table discussions and practical demonstrations dealing with the many problems related to hospital efficiency and will be of particular interest to surgeons, hospital trustees, executives and personnel generally. An invitation is extended to all persons interested in the hospital field to attend these conferences.

#### LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the Detroit session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets,

which plan has proved an efficient means of providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding as the number of tickets issued for any clinic is limited to the capacity of the room assigned to that clinic.

#### REGISTRATION FEE

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters during the meeting. This card, which is nontransferable, must be presented to secure clinic tickets and admission to the evening meetings.

#### DETROIT HOTELS AND THEIR RATES

There are ample first class hotel accommodations in Detroit for all who wish to attend, most of the hotels being located within short walking distance of the headquarters hotels. The Committee on Arrangements recommends the following hotels:

	MINIMUM RATE WITH BREAKFAST	
	Single Room	Double Room
Barlum Cadillac Sq. at Bates	\$2.50	\$4.00
Book Cadillac Washington and Michigan	4.00	6.00
Carlton Plaza 2931 John R. St.	2.50	4.00
Clifford Clifford and DuRoi	2.50	4.00
Detroit Leland Cass at Bagley	3.50	5.50
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# SURGERY, GYNECOLOGY AND OBSTETRICS

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## UTEROSALPINGOGRAPHY, ROENTGENOLOGICAL VISUALIZATION OF THE CAVITY OF THE UTERUS AND FALLOPIAN TUBES AFTER THE INJECTION OF IODIZED OILS

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UNTIL recent years, the methods of gynecological diagnosis were limited chiefly to the history, physical examination, and the gross and histological study of tissues or organs removed at operation. When Rubin's method of transuterine insufflation of the fallopian tubes was introduced and the detection of the presence of obstructions in the oviducts thus made feasible, new possibilities for exact diagnosis were suggested.

Originally the Rubin test was performed by measuring the resistance offered to the carbon dioxide gas injected, but the method proved safer and more accurate when fluoroscopic and roentgenological study were added to determine whether the injected gas had really passed through the fallopian tubes and produced a state of pneumoperitoneum. From this starting point there arose the realization that exact gynecological diagnosis would eventually require a roentgenological visualization of the female pelvic organs just as was done for the study of the renal pelvis and the ureter.

In order to render the cavity of the uterus and fallopian tubes opaque to the roentgen rays, various injection fluids were tried. Cary (6), in 1914, advocated a solution of collargol as the opaque medium for this pur-

pose. Kennedy (14) employed a 10 per cent solution of sodium bromide. Tussau (29) and also Mocquot (17), in 1925, reported on the use of a suspension of bismuth as a means of demonstrating the shape of the uterine cavity and the presence of fibroids that impinge on this lumen. None of these solutions, however, proved entirely satisfactory for the purpose of uterography and salpingography.

The most valuable work toward accomplishing roentgenological visualization of the female pelvic organs has been done with iodized oils, notably lipiodol and iodipin. This subject forms the basis of the present report.

The use of iodized oils for roentgenological diagnosis is of recent origin, dating back only to 1922. In that year, Sicard and Forestier (27) reported on the use of lipiodol, a 40 per cent combination of iodine with poppyseed oil, as a means of localizing spinal cord tumors and other obstructions within the vertebral column. Lipiodol had previously been used therapeutically as a form of iodine medication, being administered as intramuscular injections. It was accidentally noted after such injections that opaque spots continued on roentgenograms for a long time afterward. This finding,



together with the known harmlessness of the substance, suggested its use as a means of making the subdural and epidural spaces roentgenologically visible.

Lipiodol is not a solution of iodine in poppyseed oil as some writers have erroneously stated but a definite chemical compound of these two substances. It is yellowish and transparent and has the appearance of olive oil. Radiographically it possesses a high degree of opacity. It is as well tolerated by all the tissues of the body as any ordinary vegetable oil. Sicard and Forestier (27) gave more than 5,000 injections in various parts of the body and never observed any unfavorable result.

The use of iodized oils as an aid to roentgenological diagnosis was soon extended from the spinal canal to other regions of the body. Forestier and Leroux (9) in 1922 devised a suitable technique for making the lungs and bronchial tubes roentgenologically visible after intratracheal injections of iodized oil. In this country Pritchard, Whyte and Gordon (20) have successfully used iodized oils in the diagnosis of bronchial affections particularly small bronchiectatic cavities. Loeper, Forestier, and Le Forestier (15) in 1923, fed patients with gelatin capsules containing lipiodol in order to test the digestive capacity of the gastric juice. Immediately after taking two capsules, the patient was fluoroscoped, thus it was possible to determine the exact time at which the gelatin was dissolved and the lipiodol liberated.

Reverchon and Worms (22), in 1925, injected the maxillary sinuses with iodized oil and secured successful roentgenograms. Bollack (2) succeeded in outlining the lacrimal ducts after injecting 2 or 3 cubic centimeters into the canaliculus.

Iodized oil has been tried for the visualization of the pelvis of the kidney, ureter, bladder, and urethra, but the results have not generally been considered so good as those with the other methods of examining these organs roentgenologically now in vogue. Neuschwanger (18), however, on the basis of experiments on dogs and clinical observations on 27 cases, came to the conclusion that, with regard to toxicity and opacity to

the roentgen ray, iodized oils offer a pyelographic medium superior to the injection fluids in use at the present time.

In this country lipiodol is expensive and somewhat difficult to obtain. For these reasons many workers have used iodipin, a preparation manufactured by Merck. My own investigations were carried out with lipiodol.

Iodipin is iodized sesame oil containing 40 per cent of iodine in organic combination. It is an oily liquid insoluble in water. Its color is brown to black depending on the thickness of the layer examined. Its specific gravity at room temperature is 1.370 to 1.372.

#### USE OF IODIZED OILS IN GYNECOLOGICAL DIAGNOSIS

In 1925 Heuser (13) of Buenos Aires reported on the use of lipiodol as a means of making an early diagnosis of pregnancy. When a period or two have been missed, it is often quite difficult to make the diagnosis of the gravid state. Even with the most perfect apparatus it is not possible to make a roentgenological diagnosis of pregnancy without the aid of iodized oil until after the third month.

Heuser's method of diagnosing pregnancy, by means of the intra uterine injection of iodized oil and subsequent roentgenization depends on the fact that, when the gravid condition exists, the uterus is already occupied and cannot be filled by the oil, whereas, when the uterus is empty, the oil permeates the entire cavity.

When the roentgenogram shows the triangular shape of the uterine cavity and one or both tubes are filled with the liquid it is satisfactory evidence that the uterus is empty, even though the patient may have missed two periods. In the presence of uterine pregnancy, the iodized oil passes around the fetus and fails to fill the entire uterine cavity.

According to Heuser, the intra uterine injection of iodized oil does not produce abortion. As a matter of fact repeated attempts were made by some of his colleagues to produce therapeutic abortions on tuberculous women by this means, but they were

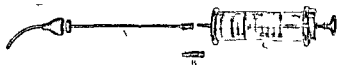


Fig 1 Modified Uitzman Keyes nozzle used for injecting iodized oil 4 The nozzle modified by means of a bayonet lock attachment The rubber tip 3 or 4 centimeters from the end prevents the escape of the fluid from the uterus B, Adapter with bayonet attachment A double adapter may be used if necessary to fit the tip of the syringe C, Ordinary 20 cubic centimeter Record syringe A Luer syringe may be used instead

all unsuccessful Because of the readiness with which the presence of any foreign body in the uterine cavity may produce abortion however, I should hesitate to employ Heuser's method for the early diagnosis of pregnancy Furthermore, the theoretical danger of damaging the contained fetus with the iodized oil would appear to be too great, although it must be admitted that such injury has not actually been demonstrated The chief importance of Heuser's work would seem to be that it opened up new vistas for gynecological diagnosis by roentgenological measures, rather than that it is a means of making an early diagnosis of pregnancy

Heuser also suggested that, by means of the injection of iodized oil and subsequent roentgen ray study, it would be possible to outline the contour of the lumen of the fallopian tubes and thus diagnose the location of the obstruction in cases of sterility due to this cause

Further observations on the roentgenological exploration of the uterus and fallopian tubes after injections of iodized oils were reported by Carelli, Gandolfo, and Ocampo (4) in 1925

In 1926, Carreras (5) reported on the advantages of iodized oils in the diagnosis of diseases of the uterus and adnexa In one case, which was supposed to be one of cancer of the body of the uterus, the roentgenogram after the injection of iodized oil revealed that the condition was really one of uterus didelphys

Stein and Arens (28) published the report of a case of ovarian cyst in which, after the injection of iodized oil, the roentgenogram clearly showed the silhouette of the ovarian growth and its adhesions to the bowel



Fig 2 X ray appearances in normal subject after injection of iodized oil 1 Triangular area showing cavity of a normal uterus B, Tortuous and somewhat distended ampullae of tubes C Normal narrow canal of isthmus of tube D Shadow of the Uitzman Keyes nozzle and volsella To obtain this uterosalpingogram 4.5 cubic centimeters of iodized oil were required

Newell (19) reported his results after intra uterine injection of iodized oil and subsequent roentgenization in 38 cases He did not observe a single unfavorable reaction He found the procedure to be of diagnostic value in cases of sterility in which the tubes are found obstructed, in such cases, it enables one to determine the character and location of the obstruction and whether or not the case is suitable for operation When several masses are palpated within the pelvis, the method clearly differentiates the uterus from the other masses Newell further found that when the pelvis is blocked by one large mass, the method makes it possible to decide whether the tumor originates from the uterus or the ovary, that one can thereby estimate the size of the uterus and determine whether its cavity is encroached upon by any masses, such as a fibromyoma or a carcinoma of the fundus, and that the injection of iodized oil proves helpful in the differentiation between chronic appendicitis and right-sided salpingitis and between tuberculous and non tuberculous salpingitis

Henkel (12) found that 2 cubic centimeters of 40 per cent iodized oil, when injected into the uterus is unirritating and gives valuable



FIG. 3. X-ray appearances in Case 1 after injection of iodized oil. A Triangular area showing uterine cavity indented on the left side. This indentation was subsequently proved to be due to compression from a large cyst in the left broad ligament. B Ampullary portion of left fallopian tube. Arising from the left cornu of the uterus there is a very narrow shadow corresponding to the proximal portion of the left fallopian tube. This short narrow tortuous shadow terminates in a distended portion. At operation it was demonstrated that the left tube was compressed by an intraligamentous cyst. The distal portion of the tube was flattened out over the tumor and closed. The right fallopian tube is not visualized and appears to be sharply cut off at the right cornu. This sharply defined termination of the right cornu was the only clue to the presence of a pathological condition in the right tube as the right adnexa could not be felt on pelvic examination. During the operation it was found that there was a right pus tube prolapsed into the cul de sac and covered by the left sided intraligamentous cyst. The latter as mentioned above extended to the left lying above and posteriorly to the uterus and thus covered the prolapsed right adnexa. C Isthmus of the left fallopian tube. D Shadow of Ultzman Keyes nozzle in vagina.

roentgen ray pictures of the uterine cavity, especially for the diagnosis of myomata and for controlling the results of conservative surgery on these neoplasms.

Gregoire Beclère and Darbois (11) employed injections of iodized oil with subsequent roentgenization in forty gynecological cases. They found that when moderate pressure was used the injections were well tolerated. In the differential diagnosis of pelvic tumors for example between fibro myoma of the uterus and cyst of the ovary, the method was very serviceable. In the diagnosis of tubal patency it proved superior to insufflation. The permeability of each tube is demonstrated separately, and the method enables one to localize the obstruction exactly.

Beclère (1) emphasized the necessity of plugging the cervix while the injection of iodized oil is being made, in order to prevent the escape of the solution into the vagina. This is especially important in testing tubal permeability. Beclère employed a canaliculated olive tipped rubber sound of suitable diameter. He advised that the iodized oil be injected under a pressure of 30 centimeters of mercury never more. When the pressure exceeds 40 centimeters it is said that the iodized oil may enter the blood vessels.

Rubin and Bendick (25) made a study of tubal peristalsis in women after injecting iodized oil so as to make the tubes fluoroscopically visible. On the basis of their observations they described three types of motion in the fallopian tubes.

Rosenblatt (23), in 1927 reported his salpingographic observations on three women who had submitted to the Alexander Adams operation for sterility. He suggests that by means of the injection of iodized oils and subsequent roentgenization, gynecologists may be able to settle finally the much disputed question concerning the value of the Alexander Adams operation for the relief of sterility.

According to Rosenblatt and Kass (24) roentgenography in gynecology is a valuable and safe diagnostic help of the first order compared with which many modern methods of investigation must remain in the background. They believe that with aseptic technique it is a faultless diagnostic measure even for ambulatory patients, but it is certainly better to employ the method only on patients who are kept in bed. Roentgenography makes it possible according to Rosenblatt and Kass to observe closely the condition of the genital organs.

McCready and Ryan (16) in 1926 published some excellent roentgenograms of the female genital tract after the injection of iodized oils. They found iodized oil a very effective agent for roentgenography of the cavity of the uterus and the lumina of the fallopian tubes. The greatest practical value of the test, in their opinion is in the determination of the patency or the position of occlusion of the fallopian tubes. They believe

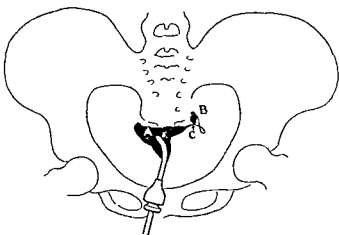


Fig 4 The same as Figure 3 drawn so as to eliminate the shadow of the Ultzman Keyes nozzle in the vagina and outline the roentgenological landmarks

that the method promises much aid in the study of sterility due to occlusion of the oviducts

Busson and Portret (3) were enabled to make the clinical diagnosis of double uterus by means of salpingography after the injection of iodized oil. Other workers who have utilized roentgenological visualization of the female genital tract, as effected by iodized oil injections, include Vercesi (30), Ferre (8), Schober (26), Randall (21), Cotte and Bertrand (7), and Forsdike (10).

#### TECHNIQUE OF INJECTING IODIZED OIL

In carrying out the transuterine injection of iodized oil, I have been guided by the same principles of asepsis as for the insufflation of gas for the performance of the Rubin test. Following is a description of the method, as I have employed it.

The patient receives an enema the night before and a second one on the morning of the examination. She is allowed only a light breakfast of toast and tea. Then she is prepared as for any ordinary vaginal operation.

The external genitals are shaved and sterile leggings placed on the lower extremities. The patient is placed in the lithotomy position. The J Bently Squier cystoscopic table is most convenient, but any table may be used, if it is equipped with a Bucky diaphragm and there are nurses to support the lower extremities.

The patient is brought to the edge of the screen. A weighted speculum is placed in the

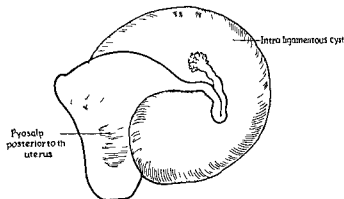


Fig 5 Condition found at operation in Case 1. Compare with Figures 3 and 4

vagina and the cervix is grasped with a volsella at a convenient place not far from the os. Sometimes it will be found easiest to grasp the anterior lip, in other cases, the posterior lip or even a lateral part of the cervix may prove more convenient.

The cervix is cleared of mucus and swabbed with an applicator dipped in iodine. The iodine is washed off with a sponge wet with alcohol. The entire vagina is swabbed with an alcohol sponge and then dried with sterile cotton sponges.

In order to determine the direction of the uterine cavity, a sound is introduced into the uterus. When the sound is removed, everything is in readiness for the actual injection.

For injecting the iodized oil, the modified Ultzman Keyes urethral nozzle shown in Figure 1 is employed. A rubber tip, to occlude the cervix and thus prevent the escape of the fluid into the vagina, is attached to the nozzle about 3 or 4 centimeters from the end. The nozzle is inserted into the uterus as far as this rubber tip. A bryonet attachment fitted to the nozzle locks the attached syringe and thus facilitates the work. Either a Luer or Record syringe may be used, and a single or a double adapter may be fitted according to the syringe.

The iodized oil, whether lipidol or iodipin, is warmed by placing the flask in hot water. This makes the oil less viscous and helps its flow. A 20 cubic centimeter Record syringe (a Luer syringe may be used) is filled to the 15 cubic centimeter mark with the oil and locked to the nozzle. The nozzle is inserted into the uterus as far as the rubber tip. The



FIG. 3 X ray appearances in Case 1 after injection of iodized oil. A Triangular area showing uterine cavity indented on the left side. This indentation was subsequently proved to be due to compression from a large cyst in the left broad ligament. B Ampullary portion of left fallopian tube. Arising from the left cornu of the uterus there is a very narrow shadow corresponding to the proximal portion of the left fallopian tube. This short narrow tortuous shadow terminates in a distended portion. At operation it was demonstrated that the left tube was compressed by an intraligamentous cyst. The distal portion of the tube was flattened out over the tumor and closed. The right fallopian tube is not visualized and appears to be sharply cut off at the right cornu. This sharply defined termination of the right cornu was the only clue to the presence of a pathological condition in the right tube as the right adnexa could not be felt on pelvic examination. During the operation it was found that there was a right pus tube prolapsed into the cul de sac and covered by the left sided intraligamentous cyst. The latter as mentioned above extended to the left lying above and posteriorly to the uterus and thus covered the prolapsed right adnexa. C Isthmus of the left fallopian tube. D Shadow of Ultzman Keyes nozzle in vagina.

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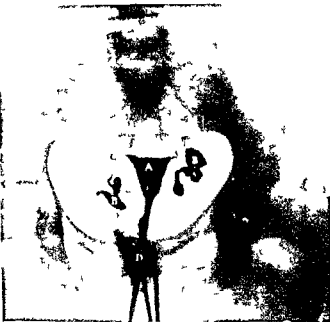


Fig 10 The same as Figure 8 after injection of still more iodized oil. Note how all the structures are better outlined. In this roentgenogram, a very narrow canal on either side representing the proximal portion of the fallopian tube may be seen. The shadows of the fallopian tubes are normal. A Uterine cavity. B The ampullæ of the fallopian tubes more pronounced than in Figure 8. C The proximal portions of the fallopian tubes. D, Uitzman Keyes nozzle and volsella in vagina.

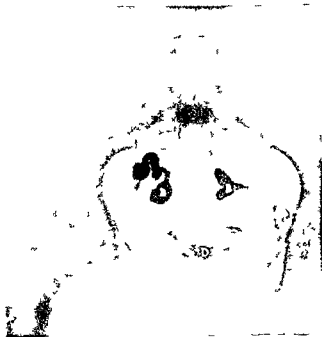


Fig 12 The same as Figure 10 after allowing the oil to drain from the uterus. The irregular shadow in the lower part of the roentgenogram D represents the oil in the vagina. The uterus is not visualized, because it has been drained of oil. The fallopian tubes B, show only at the dilated portions of the ampullæ. The picture does not show any iodized oil in the peritoneal cavity, indicating that the ostium abdominale of each tube is closed.

the vagina. The presence of oil on the screen would, of course, spoil the plate.

After two plates have been taken, the nozzle is withdrawn from the uterus and the patient pushed down from the screen. A piece of gauze is placed on the table and the patient raised, so as to allow the oil to drain from the uterus. Before the volsella is

removed, another plate is taken. This exposure invariably shows a shadow of the fallopian tubes. If they are patent, there is an accumulation of oil in the pelvis near and around the tubes. As the uterus has drained itself of the oil, it will not be shown in this picture. For this reason, when taking the final plate, it is best to introduce a sound into the uterus, in order to indicate the relationship of the tubal shadows to the uterus.

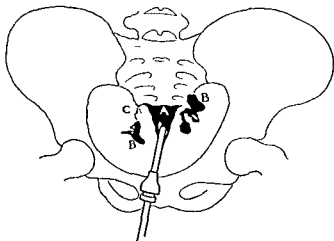


Fig 11 The same as Figure 10 drawn so as to eliminate the shadows of the volsella and Uitzman Keyes nozzle in the vagina and outline the roentgenological landmarks.

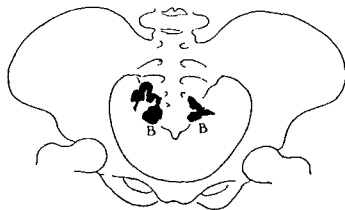


Fig 13 The same as Figure 12 drawn so as to eliminate the extraneous shadow in the vagina and outline the roentgenological findings.



Fig 14 The same as Figure 8 72 hours after injection The roentgenogram shows that the iodized oil has gathered in the distended and closed portions of the ampullæ B on both sides No oil is seen in the peritoneal cavity A plate taken 10 days later showed no change in the size and shape of the shadows of the tubes Evidently there was hardly any absorption of the iodized oil from the fallopian tubes during that period

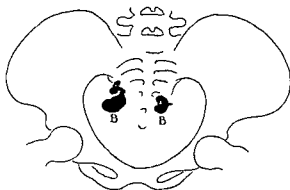


Fig 15 The same as Figure 14 drawn so as to outline the roentgenological findings

tion of iodized oil I have always insisted on rigid asepsis and a careful selection of cases It may perhaps be due to this fact that although I have performed gas insufflation in a large number of cases over a period of years and have also given a limited number of injections of iodized oil to date I have not as yet met with any untoward effects

#### REPORT OF CASES

In the following brief case histories only the pertinent data are given The principal findings on roentgenological examination are described in the legends to the X ray pictures Figure 2 shows the roentgenological findings in the normal subject after the injection of iodized oil It may conveniently be used for the purpose of comparison in examining the roentgenograms of the case histories appended

**CASE 1** M S aged 45 complained of primary sterility There was a history of pelvic peritonitis 5 months previously Bimanual examination revealed a large cystic mass extending to the left wall of the pelvis and lying above and posteriorly to the uterus The right adnexa could not be felt The patient received an injection of iodized oil and was then subjected to roentgenological study The roentgen ray findings are shown in Figures 3 and 4 Subsequently laparotomy was performed and the operative findings as shown in Figure 5 accounted completely for the X ray appearances There was a large cyst in the broad ligament In this case the only clue to the presence of a lesion affecting the right tube was furnished by an occlusion at the isthmus During the operation a right sided pus tube was found in the cul de sac where it had escaped detection on pelvic examination because

During the injection some patients may complain of cramps These are due to the distention of the internal genitalia At such times it is advisable to diminish the force of the injection or to stop for a few seconds until the patient has had time to accommodate herself to the condition Some patients may complain of feeling faint Under such circumstances it is wise to stop for a while reassuring the patient that the uncomfortable sensation is only temporary

I prefer not to use the bivalve speculum, because it cannot be removed when the pictures are taken and thus throws confusing shadows This annoyance is avoided by using a weighted speculum and removing it before taking the pictures

It is advisable to take another picture after 24 hours If the shadow in the pelvis persists, another plate should be exposed after a week

After a few hours the subject feels none the worse for her examination However, I make it a rule to enjoin rest for at least a day Both in the insufflation of gas and the injec



Fig 16 The same as Figure 8 with the exposure taken from the oblique position. A right or left oblique view is important as an aid to visualizing the two fallopian tubes separately, inasmuch as a massed appearance may be due to the superimposition of one tube upon the other especially that portion of the tube which extends in an anterior or posterior direction. It is also important to leave the cannula in the uterus as a landmark to determine the position of the fundus. A Oblique view of uterine cavity B, Fallopian tubes, oblique view D, Uitzman Keyes nozzle in vagina



Fig 18 X-ray appearances in Case 4 after injection of iodized oil. A Triangular cavity of uterus well outlined B Ampullae of fallopian tubes C Isthmuses of fallopian tubes Both the proximal narrow C and the distal broader, B portions of the tubes are directed upward and well outlined. The ends of the tubes were so patent that the opaque substance rapidly entered the peritoneal cavity and may be seen as high as the level of the fourth lumbar vertebra D, Shadow of volsella and Uitzman Keyes nozzle in vagina

it was covered by the posterior portion of the left broad ligament cyst

CASE 2 H K, aged 28 married 5 years complained of primary sterility. She gave a history of



Fig 17 The same as Figure 16 drawn so as to eliminate the shadow of the Uitzman Keyes nozzle in the vagina and outline the roentgenological landmarks

having some pelvic trouble soon after marriage. On bimanual examination, the uterus was found to be of small size, sharply anteflexed and pulled to the right side by very much shortened right adnexa. The cervix was conical in shape. The patient received an injection of iodized oil and was then subjected to roentgenological study. The roentgen ray findings are shown in Figures 6 and 7

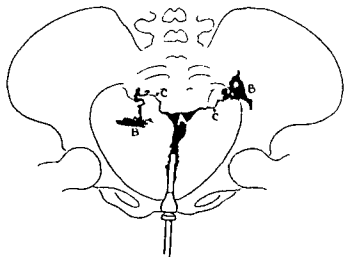


Fig 19 The same as Figure 18 drawn so as to eliminate the shadows of the volsella and Uitzman Keyes nozzle in the vagina and outline the roentgenological landmarks





Fig. 20 The same as Figure 18 24 hours after the injection of the iodized oil. Large masses of the opaque substance are scattered throughout the peritoneal cavity as high as the level of the fourth lumbar vertebra. D Iodized oil that has drained into the vagina.

CASE 3. M. B. aged 34, no children, one abortion 11 years previously. She was very ill at the time of the abortion and since then had suffered from abdominal pain which was worse at the menstrual periods. Backache was severe. Pelvic examination revealed a retroposed uterus of moderate size. The fallopian tubes were thickened and readily palpable. There was more pronounced thickening at the distal portions giving the impression that the tubes were adherent to the lateral walls of the pelvis. The patient received an injection of iodized oil



Fig. 21 The same as Figure 18 3 days after the injection of the iodized oil. A large part of the opaque substance has been absorbed.

and was subjected to roentgenological study. The roentgen ray findings are shown in Figure 8 to 17 inclusive.

CASE 4. B. L. aged 30, married 5 years, complained of primary sterility. She had been inflamed with gas one year previously at which time the tubes proved to be patent. The patient received an injection of iodized oil and was then subjected to roentgenological study. The roentgen ray findings are shown in Figures 18 to 22 inclusive.

CASE 5. S. S. aged 25, married 4½ years, complained of primary sterility. The patient received an injection of iodized oil and was subjected to roentgenological study. The roentgen ray findings are shown in Figures 23 to 26 inclusive.

CASE 6. R. C. aged 26, married 1 year, complained of primary sterility. The patient received an injection of iodized oil and was subjected to roentgenological examination. The roentgen ray findings are shown in Figures 27 and 28.



Fig. 22 The same as Figure 21 drawn so as to outline the roentgenological findings.

That the intra uterine injection of iodized oil is a harmless procedure when carefully performed has been attested by the observations of many workers in this field. Even when the test is performed on ambulatory patients unfavorable reactions are rare. However, I do not advise the intra uterine



Fig. 23. X-ray appearance in Case 5 after injection of iodized oil. *A* Large triangular shadow of the cavity of the uterus. *B* The ampullary portions of the fallopian tubes. The right tube is long and tortuous, the left shorter. Both tubes are ending in the dilated portions of the ampullae and are beginning to empty into the peritoneal cavity. *C* The isthmus of the right fallopian tube. *D* Shadows of volsella and Ultzmann Keyes nozzle in vagina.



Fig. 24. The same as Figure 23, 4 hours after the injection. The picture shows greater and less amounts of the opaque substances scattered throughout the peritoneal cavity as high as the level of the sacro iliac joints.

injections unless the patient can be kept in bed. In my own practice, I have never observed any untoward results.

Symptoms of iodism have not been observed after the injections. As has been pointed out before, lipiodol and iodipin are not solutions of iodine but definite chemical compounds of iodine with poppyseed oil and sesame oil, respectively. Apparently this combination is maintained in the body, for a time at least, and iodine is not liberated rapidly enough to give rise to toxic manifestations.

None of my patients showed any signs of iodism. In every case, the urine was examined repeatedly but found negative for the presence of iodine. It would have been interesting to examine the blood also for the presence of iodine, unfortunately, this was not done.

Roentgenograms are best taken after from 4 to 7 cubic centimeters of the iodized oil has been injected. In some cases, clearer salpingograms are obtained after the injection of still larger amounts of the opaque medium (Fig. 10).

In cases in which the fallopian tubes are patent, or in which they are closed but be-

come patent during the test, the iodized oil distributes itself in the peritoneal cavity and there shows faint and widely distributed shadows. Such shadows may persist for a variable length of time. In some cases, all trace of the opaque oil disappears within 2 weeks of the injection, in others, faint traces may be observed after 2 months. On successive roentgenograms, the shadows become fainter and fainter until they disappear completely.

The exact mode in which the iodized oil is absorbed and its ultimate fate in the body have not yet been definitely worked out. Although it is apparent that the absorption is probably by way of the lymphatic pathways, no shadows could be observed that could be assumed to be lymphatic glands filled with the opaque oil. This problem offers a field for further study.

When the ostium abdominale is closed, the iodized oil remains in the ampullary portion of the fallopian tube. In one of my cases, a roentgenogram taken 4 weeks after the injection showed no trace of the opaque substance in the peritoneal cavity and no evidences of absorption from the ampulla.



Fig 25 The same as Figure 23 5 days after the injection. The picture shows that a considerable amount of the opaque substance has disappeared from the peritoneum. The remaining portions however are distributed over a wider area than in the plates previously taken.

Very little absorption seems to take place through the walls of the tube. Repeated roentgenograms on this case showed that the proximal portion of the tube would be found emptied and refilled indicating that there is a peristalsis of the tube from the periphery toward the uterus and the possibility where the tube is closed at the ostium abdominale that the oil may be draining through the uterus.

There is no evidence that the iodized oil damages the epithelium of the fallopian tube, with which it remains in contact so long. On the contrary, surgeons who have performed laparotomies upon patients recently subjected to the injection of iodized oil and examined the fallopian tubes directly have reported that the epithelium shows no evidence of injury under such circumstances.

During the injection of the iodized oil the cervix must be well plugged otherwise there will be a return flow into the vagina producing deceptive shadows. Furthermore the drainage of the oil from the uterus might result in a failure of the oil to enter the fallopian tubes.



Fig 26 The same as Figure 25 drawn to outline the roentgenological findings.

It is not necessary to use a manometer for the determination of the amount of pressure required. However the pressure maintained by the syringe must be steady, gentle and continuous while the pictures are being taken. If too much pressure is used the patient will become restless and complain of pain. The pictures are best taken in the dorsal recumbent position. When there is a question of superimposition of the fallopian tubes an oblique view may be obtained by placing the subject in the lateral prone position.

By means of roentgenological study after the injection of iodized oil an accurate uterogram and salpingogram visualizing the entire internal female generative tract may be obtained in cases in which the fallopian tubes are not occluded. When there is an occlusion the procedure enables one to determine its exact location. Such information is of great value in the treatment of obstructive sterility as it may enable one to decide on the advisability of operative interference for the purpose of performing a plastic operation on the occluded tubes. For example if roentgenological study after the injection of iodized oil shows an obstruction of the ampulla it may be readily understood that a new stoma at this point might produce fertility.

The roentgenological visualization of the uterus and fallopian tubes made possible by means of the intra uterine injection of iodized oil may be of definite value in the diagnosis of the nature and location of pelvic tumors.



Fig 27 X ray appearances in Case 6 after injection of iodized oil. A Triangular cavity of the body of the uterus. Note the elongated left cornu. B, Ampullæ of fallopian tubes, very tortuous. There is an excess of opaque substance escaping through the ostium abdominale of each tube and distributing itself in the peritoneal cavity around the fimbriated ends of the tubes. C The canal of the isthmus of each tube. Note how narrow the lumen is at this point. D The shadow in the vagina produced by the volsella the Ultzman Keyes nozzle and the iodized oil escaping from the cervix into the vagina.

When the oil escapes through a patent ostium abdominale, it tends to distribute itself in the pelvis in such a manner as to throw opacities around the tumor mass. When the tumor is located in the vicinity of the uterus, it may impinge on that organ to such an extent as to indent its cavity, as outlined by means of the injected iodized oil (see Case 1).

In interpreting uterograms and salpingograms, one must familiarize himself with the various forms that the shadows may take. When the fallopian tubes are patent and the oil escapes into the peritoneal cavity, their lumina may be tortuous and folded on themselves in such a manner that the shadows may be superimposed. Therefore one must study plates made at successive intervals and sometimes make the exposures from different angles in order to arrive at a correct interpretation.

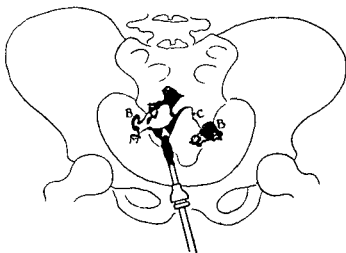


Fig 28 The same as Figure 27 eliminating the shadow in the vagina and outlining the roentgenological findings.

### CONCLUSIONS

1 Roentgenological visualization of the uterus and fallopian tubes after the intra-uterine injection of iodized oil furnishes a valuable means of exact gynecological diagnosis in selected cases.

2 In cases of sterility, the procedure gives us information as to whether the tubes are patent or not and also localizes the site of the occlusion. It not only supplements the insufflation of gas but often supplants it.

3 The technique is simple, but strict aseptic precautions must be taken. I am firmly opposed to the performance of the test on ambulatory patients.

4 Properly performed, the test outlines the uterus and the various portions of the fallopian tubes with great distinctness.

5 Proper interpretation of the roentgenological findings requires experience in this field. In some cases, it is advisable to examine plates exposed at successive intervals or from different angles.

6 In my experience, the intra uterine injection of iodized oil is entirely safe and harmless, and no manifestations of iodism have been observed.

I wish to express my gratitude to Dr. Charles Gottlieb for his courtesy in directing the roentgenological work connected with this investigation.

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## TORSION OF HYDROSALPINX

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A CONSIDERABLE literature has appeared recently, largely in the form of case reports, upon the subject of torsion of the fallopian tube. While this anomaly, particularly torsion of hydrosalpinx, has long attracted widespread interest, and has elicited, it would seem, sufficient study to establish it on a clear cut basis, a review of the newer case reports and the discussions appending them reveals two rather striking discrepancies in our knowledge of the subject. (1) A noticeable variation appears in the stated frequency of the condition, some writers considering it of the rarest occurrence, being able to collect in one instance only nine recorded cases, while others believe it "not uncommon", (2) an increasing number of cases are being reported as torsion of the normal fallopian tube. Does torsion of the normal tube occur, or do supposed instances of this represent, as the earlier writers insisted, examples of torsion of an already existing hydrosalpinx? It is the intention of this paper to comment briefly upon these two problems and to report three new cases of torsion of hydrosalpinx.

The first published observation of torsion of hydrosalpinx appeared in England in 1891, Bland Sutton reporting without details the history of a case operated on by Henry Morris whom he assisted. In the following year came the first report from France, Pierre Delbet giving complete details of a case and noting (as has been frequently emphasized since) the similarity between the appearance of the tumor and that of strangulated intestine. He was forced in the presence of a black twisted tumor "to unroll the entire pack of intestines in order to assure himself that the tumor was not a part of the gut." Then followed, from time to time, the observations of Taylor and Bell in England, Russell, Hirst, and Storer in the United States, Stroganoff and Warnek in Russia, Veit, Fritsch, Sanger, and

Arthur in Germany, Hartmann and Raymond Legueu and Chabry, Pozzi, and Lejars in France.

The first collective studies of the condition were published by Præger of Germany and Cathelin of France, in 1899 and 1900 respectively. The latter made an exhaustive survey of the etiology and pathology and tabulated 41 cases from the literature. An investigation of the original references covering these cases, however, indicates that six at least of Cathelin's list were not torsion of hydrosalpinx as we understand the term. Thus the case of A. Martin (Case 6 in Cathelin's table) was frankly one of torsion of a tubal pregnancy, the placenta and oval sac being found in the tube, the third case of Warnek's (Case 41) was demonstrated microscopically to be primary carcinoma of the tube, that of Hennig (Case 7, misspelled "Henning") was a hæmorrhagic tubal necrosis with fatal rupture which occurred during an attack of typhoid, no mention of torsion being made, the case of Jacobs (Case 17) was evidently one of pyosalpinx in which torsion had been gradual as a result of adhesions. The cases of Napier (Case 4) and Fochier (Case 36) were probably torsion of ovarian cysts. Deducting these cases, a total is reached of 35 authentic cases reported prior to 1900.

Anspach's detailed study of torsion of tubal enlargements which appeared in 1912 lists 62 cases of torsion of hydrosalpinx. He includes 31 of Cathelin's series. Four cases tabulated by the latter and omitted by Anspach,—namely, Russel's (Case 11), Legueu's (Case 20), Lejars' (Case 40) and Ricard's (Case 35)—seem to be sufficiently authentic to warrant their inclusion, giving a total of 65 cases on record before 1912.

Any attempt to tabulate an accurate list of cases since 1912 is complicated by the numerous cases of torsion of the normal tube reported during the past decade. The ques-



Fig 1 Cross section of tubal mass just distal to strangulation showing isthmal portion of tube, and coiled beneath it the collapsed walls of the distended ampullary segment. Note massive hematosalpinx (Case 1)

tion resolves itself of course into one of authenticity of nomenclature which cases, if any represent torsion of normal tubes and



Fig 4 Photomicrographs through tube wall showing separation of muscle fibers by blood distention of villus (by blood) and thrombosis of vessels (Case 2)

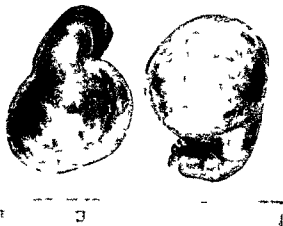


Fig 2 (left) Anterior view of twisted hydrosalpinx showing characteristic retort shape (Case 2)

Fig 3 Posterior view of twisted hydrosalpinx showing typical distention of ampullary portion (Case 2)

which torsion of hydrosalpinges? While in many cases this is easy of answer in some it is impossible. Writers who insist that torsion of normal adnexa does occur support their attitude on the ground that many of the cases are seen in virgins and particularly in girls of puberty age in whom an already existing hydrosalpinx would seem unlikely more over at operation no adhesions or other evidence of antecedent pathological changes are found. The earlier writers, particularly Anspach hold to the view that in such cases the tube is the seat of an hydrosalpinx before torsion and that it is converted into a hematosalpinx as the result of twisting. They explain the existence of a hydrosalpinx in virgins and in patients who give no history of pelvic inflammation on the following basis: (a) it may occur as a sequela of a vulva vaginitis in childhood which persists in latent form until puberty and then produces involvement of the tube which is not recognized, (b) it may be the late result of an unrecognized salpingitis which has occurred in the course of one of the exanthemata, (c) it may be the result of an attenuated tuberculous infection. When it is recalled that unilateral hydrosalpinges are occasionally seen without other pathological changes and that torsion of a normal tube immediately produces an identical picture, namely, hydrosalpinx and

hæmatosalpinx, the difficulty of distinguishing between torsion of a hydrosalpinx (in certain cases) and torsion of a normal tube becomes apparent. In either instance the operative findings might be the same, namely a massive distention, usually of the ampullary portion of the tube with hydrosalpinx hæmatosalpinx and a bluish discoloration due to passive congestion. Although various arguments may be adduced to support both sides of the question, no absolute proof or disproof of either contention seems available and the problem remains apparently an open one.

While difficulty of definition therefore renders unprofitable, if not futile, any effort to list accurately the cases of torsion of hydrosalpinx since 1912, an approximate impression of the recorded cases may be obtained from the following list of writers who have, during this period, reported one or more cases designating them as torsion of hydrosalpinx: Whitacre, 2 cases, Lory, 2 cases, Perrin, 2 cases, Tournoux, 2 cases, Sampson, 2 cases, Stein, Roeder, Nash, Jauch, Mayer, Hedley, Pircaux, Cavagnis, Peraire, Rubsamen, Lop, Polak, Montgomery, each 1 case, Guyot, Princetau, and Mignan, 1 case, Berquet and Romnay, 1 case, Mouchette and Perillat, 1 case.

A minimal estimate is accordingly reached of 91 cases of torsion of hydrosalpinx on record to date. That the true incidence is higher than this figure would indicate is suggested by several facts. Of particular interest in this regard is the frequency with which individual operators have met and recorded two or more cases. Lejars alone reported 8, H Hartmann 5, Legueu 3, Pozzi 3, numerous writers have recorded meeting 2 cases. Not only is this an argument against the likelihood that the condition is rare, but it suggests the possibility that individual cases have not been reported because it did not seem worth while to report single cases when several writers had already recorded meeting multiple ones. Substance is lent to such a belief by the fact that commentators on case reports have in several instances referred to one or more cases which they had met but not recorded (Sampson, 2 cases, Polak, Montgomery). The following 3 cases of torsion of hydro-

salpinx, which occurred within 3 years in a relatively small series of 640 gynecological operations, would seem further to indicate that the condition is more frequent than is generally believed.

CASE 1 (Hosp No 9346). A married Chinese woman 36.41 entered the Peking Union Medical College Hospital on October 30, 1924, complaining of pain in the right lower abdominal quadrant of 10 days' duration.

The patient had always enjoyed good health. Although married since the age of 17, she had never been pregnant. She denied venereal infection but had always had a certain amount of leucorrhœa, worse during the past year, most marked since the onset of the present illness. Menstrual history, apparently normal. Last menstrual period, October 25, 1924.

Ten days prior to admission the patient experienced a sudden attack of pain in the right lower quadrant. This was only moderately severe and soon subsided. She noted afterward, however, a mass in the lower abdomen. Five days later she again suffered pain in the right lower quadrant, this time stabbing in character and sufficiently severe to cause her to go to bed. Although nauseated she did not vomit. The pain, with occasional brief remissions, persisted until her entry into the hospital.

Although crying out occasionally with pain the patient's general condition was excellent. Temperature, 37.6, pulse 84, respiration 20, white cell count, 10,000. Examination revealed the following positive findings: there was a definite bulge of the lower abdomen, especially on the right side. Over this area both voluntary and involuntary muscle spasm was present with exquisite tenderness even on slight pressure. On vaginal examination a soft, globular mass about 15 centimeters in diameter was palpable in the right fornix.

Pre-operative diagnosis, torsion of ovarian cyst. At operation the right tube was found twisted clockwise, two and one-half times. The point of torsion was about 2 centimeters from the uterine end of the tube, the distal portion of the tube being distended into a thin-walled, purplish mass, 15 by 8 by 8 centimeters. The ovary was not involved in the torsion. A few filmy adhesions easily separated, attached the tube to surrounding structures. The left tube was also the seat of a hydrosalpinx. Bilateral salpingectomy was performed. There was an uneventful recovery.

Pathological examination showed hydrosalpinx, massive hæmatosalpinx and acute perisalpingitis (Fig 1).

CASE 2 (Hosp No 12102). A married Chinese woman, age 29, entered the Peking Union Medical College Hospital October 26, 1925, complaining of pain in the right lower abdominal quadrant of 24 hours' duration.

The patient had always enjoyed good health with the exception of an attack of measles at the age of



16 accompanied by a cough and hæmoptysis. Although married at the age of 16 she had never been pregnant. Venereal infection denied. Menstrual history apparently normal. Last menstrual period October 4, 1925.

At 1 p.m. on the day prior to admission while lifting a chair the patient was suddenly seized with severe stabbing pain in the lower right abdominal quadrant associated with nausea and vomiting. The pain increased in severity until at 3 p.m. it was said to be agonizing. She felt weak, but there was no sudden sensation of collapse. With occasional slight remissions the pain had persisted until admission into hospital.

The positive findings on examination were tenderness and rigidity over the right lower quadrant with a palpable mass extending from the pelvis on the right side to a point about 1 centimeter below the level of the umbilicus. Vaginal examination revealed a tender fluctuant mass about 12 centimeters in diameter in the right fornix. General condition excellent. Temperature 36, pulse 76, respiration 20, white blood cells 11,600.

Pre-operative diagnosis: torsion of ovarian cyst. At operation the right tube was found twisted 3 times counterclockwise at a point about 3 centimeters from the uterine end. The distal portion was distended into a glistening bluish mass 12 by 10 by 10 centimeters. The ovary was not involved in the torsion. There was no evidence of adhesions. The left adnexa as well as the other pelvic structures appeared normal. Right salpinxgectomy. Uneventful recovery.

Pathological examination showed hydrosalpinx and hæmatosalpinx (Figs 2, 3 and 4).

CASE 3. A married Chinese woman, age 23, 7½ months pregnant entered the Douw Hospital Peking on January 3, 1923, complaining of pain in the right lower abdominal quadrant of 3 days' duration.

Her past history was unimportant. She had never hitherto had pain in the right lower quadrant. Her last menstrual period had been May 24, 1922, this being her first pregnancy. The course of the gestation had apparently been normal.

Three days prior to admission she was seized with severe pain in the right lower quadrant associated with nausea and vomiting. The pain radiated down the right leg. She came to the hospital thinking she was having a prolonged and perhaps obstructed labor.

Examination revealed marked tenderness and muscle spasm over right lower quadrant. Vaginal examination revealed marked tenderness high in the right fornix, the presence of the fetal head in the pelvis obscured further findings. Her general condition was good. Temperature, 37.2; pulse, 90; respiration, 24.

Pre-operative diagnosis: acute appendicitis. At operation done by Dr J. H. Liu of the Peking Union Medical College the right tube was found twisted close to the uterine end and the distal por-

tion massively distended with blood. The ovary lay as a swollen almond shaped sac on the wall of the distended tube. The operation being done through a McBurney incision it was impossible in the presence of the pregnant uterus to inspect the opposite adnexa. Right salpingo-oophorectomy. Uneventful recovery. Normal delivery 5 weeks later.

Pathological examination showed hydrosalpinx, hæmatosalpinx and cysts of ovary.

The cases present several features of interest. They illustrate clearly the clinical similarity between torsion of hydrosalpinges and torsion of ovarian cysts, but bear out the observation of Roeder and others, that the general picture is much less alarming when the tube rather than the ovary is twisted, it will be noted that although the duration of torsion in our cases varied from 24 hours to 5 days, none of the patients exhibited elevated pulse rate or other evidence of shock. This seems to be a differential diagnostic point of some importance. Case 2 is of interest as exemplifying the type of condition that is frequently reported as torsion of the normal fallopian tube; the patient was nulliparous and there was neither history nor sign of antecedent pathological change in the pelvis. We are inclined, however, until torsion of the normal tube becomes a more soundly established entity to consider this as torsion of a hydrosalpinx. Cases occurring in conjunction with pregnancy, as Case 3, have been reported by Hartmann, fifth month, Ward, fourth month, and Peraire, third month. In a case reported by Pinard and Piquay, the patient after suffering severe attacks of lower abdominal pain during late pregnancy was operated upon a few days after delivery and torsion of a hydrosalpinx found. In Aulhorn's case reported as torsion of a normal tube there was a 3 months' pregnancy. In all of our cases the torsion involved the right tube, while this may be partly a matter of coincidence, our present knowledge of the condition indicates that it occurs much more frequently on this side.

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## RECENT ADVANCES IN OUR KNOWLEDGE OF HYDATID DISEASE

ECHINOCOCCUS CYSTS<sup>1</sup>

By L. E. BARNETT CMG FRCS (ENG) FACS DUNEDIN NEW ZEALAND

Emeritus Professor of Surgery University of Otago

WHEN asked to address this assembly of American Surgeons on some scientific topic of importance I thought that I might possibly interest you for my allotted term of 20 minutes by talking about some of the recent advances that have been made in our knowledge of hydatid disease.

We all know that hydatid disease is extremely rare in North America just as it is in Great Britain but in many parts of South America notably the Argentine Republic Uruguay and Paraguay where the American College of Surgeons has many representatives hydatid disease is so common and is increasing so rapidly as to constitute a national peril. The leading surgeons in these countries count their cases not in twos or threes but by the thousand.

In several other parts of the world especially where sheep raising is a prominent industry hydatid disease is of frequent occurrence both in man and stock animals. In Iceland in Australia and in my country New Zealand surgeons can count their cases at any rate by the hundred and in many other parts of the world particularly in Central and Southern Europe and the Mediterranean littoral hydatid disease is fairly common. The literature dealing with this remarkable parasitic malady has been vastly increased of late years by innumerable contributions from workers in all these countries. I gratefully acknowledge that the author from whom I personally have learned most is Professor Felix Deve of Rouen whose valuable researches on the *tenia echinococcus* will I hope shortly be published in book form.

In the time at my disposal I can only touch on a few points which may stimulate attention to more detailed publications.

At the outset let me remind you that the dog which except for other such dog-like animals as the wolf, jackal and fox is the one

and only host for the adult *tenia echinococcus* becomes infected by swallowing the hydatid cysts that so often occur in the liver and lungs of sheep and other stock animals for you will remember that the cystic stage of *tenia echinococcus* can be developed in a large selection of animals besides man. It is unfortunately a common and most reprehensible practice among well meaning but ignorant farm workers and shepherds after killing a sheep or an ox to throw the raw offal to their dogs for food regardless of the fact that this offal very often contains hydatid cysts and so it comes about that in certain countries quite a large proportion of the dogs become the hosts of the adult tapeworm.

## THE TRANSMISSION OF THE HYDATID PARASITE FROM DOG TO MAN

The adult *tenia echinococcus* unlike others of the cestode breed is an extremely small tapeworm. It does not measure more than 6 millimeters in length and it has never more than 4 segments but its lack of stature is fully compensated for by its multiplicity and fecundity. It can be found in hundreds sometimes indeed in thousands among the villi of the upper intestine of the infected dog and each ripe proglottis as it falls off into the lumen of the bowel carries with it some 500 fertile ova. One can realize therefore what a vast number of these ova must be passed daily in the excrement of the dog. This excrement is dried trampled pulverized scattered by the traffic of animals and distributed widely by wind and water. The hair about the dog's body, his paws his muzzle are contaminated and so too must be the wool of sheep and the coats of other animals. A human being who pats fondles and frolics with or otherwise handles a country dog or maybe a sheep, runs a decided risk of getting the ova on to his hands, and from the hands to the mouth is an easy and obvious transference. In

<sup>1</sup>Read before the Clinical Congress of the American College of Surgeons Montreal Oct. 29-30-31

accordance with the usual textbook statements, I used to believe and teach that the swallowing of water open to pollution by dogs and the eating of raw vegetable material such as watercress, lettuce, and celery that was liable to contamination by dogs' excreta were the ordinary paths of infection from dog to man, but a larger experience has led me to change my opinion. I admit, of course, that the indirect transmission through water and vegetation does happen, but I think it is of rare occurrence, whereas the direct contagion from the dog to the hands and hence to the mouths of human beings is the rule. Sheep and cattle, horses and pigs pick up hydatid infection with the contaminated herbage they eat, rarely I should say from the water they drink, firstly because the number of ova likely to get into water is comparatively small, and secondly because such ova as do get into water soon sink to the bottom.

From the point of view of prophylaxis therefore, the two chief warnings that should be everlastingly drilled into the minds of those who have to deal with dogs in a hydatid country are

1 Do not infect your dogs with the hydatid tape worm by feeding them on the raw offal of sheep and cattle that harbor cysts

2 Do not infect yourself with hydatid cysts by swallowing the minute invisible eggs passed in the motions of infected dogs. These eggs cling to the coats of dogs and possibly other animals and may easily get on to your hands and thence to your mouth

#### THE ANATOMICAL LOCATION OF HYDATID CYSTS IN HUMAN BEINGS

In addition to the biological and tissue affinities concerned with the selective location of all parasites there are some interesting anatomical influences concerned with the migration of the *tænia echinococcus* embryos. After the ova are swallowed the digestive juices dissolve the chitinous capsules and liberate the contained embryos. These are about the size of megalocytes and are provided with piercing and burrowing implements in the form of three pairs of little specialized spines which enable them to work their way

through the mucous membrane of the stomach and duodenum into the richly vascular subjacent tissue where thin walled and comparatively large radicles of the portal vein are encountered and penetrated. They are then carried in the blood stream along the portal vein to the capillaries of the liver. Their further progress is hindered by their size and by their spiny projections so that they become in large measure filtered out in the hepatic capillaries. Deve fed young pigs with hydatid ova and found the embryos embedded in the liver within a very few hours after the feeding. Dew of Melbourne recently corroborated the findings of Deve and also reported the discovery of embryos in the portal vein.

A proportion of the embryos wriggle their way through the hepatic filter and come to rest in the pulmonary capillaries. Only a few reach the systemic circulation. Clinical observation reveals that approximately 70 per cent of human hydatid cysts occur in the liver, 10 per cent in the lungs and the remaining 20 per cent in various other parts of the body.

This ratio does not hold for all other animals, in several of which the pulmonary cysts outnumber the hepatic.

#### THE VERSATILE ROLE OF THE SCOLEX

From the embryo under favorable conditions a cyst is developed and a cyst which reaches the size of a walnut or a hen's egg (some grow as large as a football) is sure to contain myriads of the embryonic tapeworm heads called scolices. These, if swallowed by a dog, develop into adult tape worms, but if they remain in the body of man or any other intermediate host they may undergo a metamorphosis into a new generation of cysts. This used to be stigmatized as a biological heresy but its common occurrence has been proved absolutely. Daughter cysts endogenously or exogenously situated in regard to the parent parasite can develop from scolices. If the parent cyst bursts or leaks into the abdominal cavity, the pleural cavity, the pericardial cavity, the interior of the heart or great vessels, the extravasated scolices, wherever they lodge, may form secondary

# A FIBROLIPOMA CLOSELY SIMULATING IN FORM AND LOCATION A TUMOR OF THE RIGHT KIDNEY, SUBACUTE APPENDICITIS

By THOMAS S. CULLEN, M.B., F.A.C.S., BALTIMORE

From the Gynecological Department of the Johns Hopkins Hospital and University

THE patient was a small girl who exhibited signs of digestive disturbance with pain in the right lower abdomen. That she had a mild appendicitis was clear. She also had a firm, somewhat lobulated tumor in the right abdomen. This tumor extended well up under the ribs and below reached well down within the crest of the ilium. Without hesitancy we diagnosed a right renal tumor.

At operation the tumor was found to be a fibrolipoma which had developed in the fat

just below the right kidney. The right kidney, which was normal, had been crowded upward. The subacute appendix was easily removed through the floor of the tumor incision.

C. H. I. No. 39340. Donna L. was seen in consultation with Dr. Mary Ingram on March 4, 1926. The child was 6 years old, was anemic and easily tired. For the past 6 weeks she had had but little appetite and 3 weeks before admission had vomited considerably after eating some ice cream. Shortly thereafter she developed an afternoon temperature. As it was thought she might have worms she was

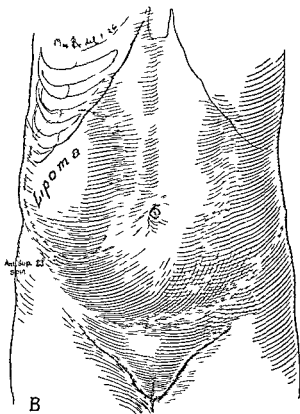
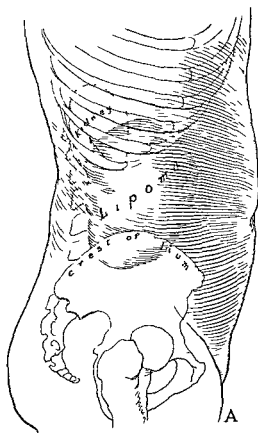


Fig. 1. A fibrolipoma simulating tumor of the right kidney. C. H. I. No. 39340. The tumor was 9.5 by 8 by 7 centimeters. A is a lateral view. The tumor extended well up under the costal margin. Its lower portion

was densely adherent to and extended below the crest of the ilium. B is the front view. The contour of the tumor as seen from the front resembles a renal growth. It projects very little from the surface of the abdomen.

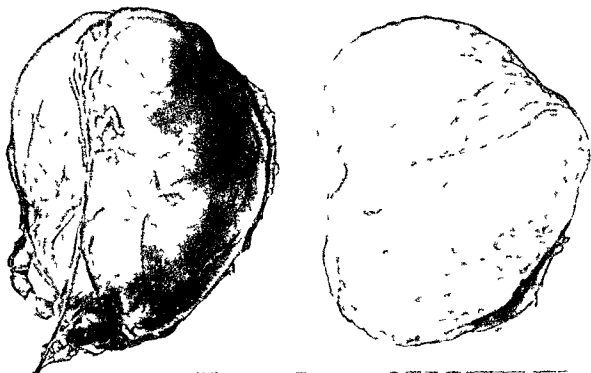


Fig 2 A fibrolipoma developing in the right renal pocket J H H Gyn Path No 31715 The left figure shows the lipomatous growth There are very few vessels on the surface The chief point of fixation was at the crest of the ilium The right figure shows the tumor on section It is composed in large measure of fat The fine trabeculae and the whitish areas are fibrous (4/5 actual size)

given appropriate medicine Her temperature rose two or three degrees She had been in bed for the 2 weeks before I saw her

On examination the child looked undernourished, underdeveloped and very anæmic There was some tenderness in the appendix region and in the right upper quadrant posteriorly was a hard, firmly fixed tumor about 8 centimeters in diameter and some what resembling a kidney (Fig 1) Above, it extended up under the ribs, below it reached below the crest of the ilium It looked as if we were dealing with a tumor of the right kidney The child was admitted to the hospital on the following day

The urine was examined, chemically and microscopically, on March 26, 27, 28, and on each occasion was found to be normal The phthalein output showed no abnormality

My colleague, Dr Guy L Hunner, examined the patient and dictated the following "The abdomen looks normal There is slightly more fullness in the right lateral flank than in the left, this is on vision On palpation the left kidney is not felt The right kidney is apparently the mass filling the right flank, one can get completely between the upper pole and the costal margin The liver border is apparently in about the normal position and there is no connection between it and the mass in the flank The mass in the right flank is about two or three times the size of a normal kidney It is divided into two portions an inner triangular portion which has its apex just beside the umbilicus

and has the consistency of a normal kidney The outer portion, making up about two thirds of the entire mass, is rather globular in outline, fills the midflank region, and has a more firm consistency"

Cystoscopic examination by Dr Hunner showed a normal bladder and left ureter As the urinary output and the urine itself seemed to be normal, further study was omitted on account of the child's age

The hæmoglobin was 60 per cent, white blood corpuscles 10 900

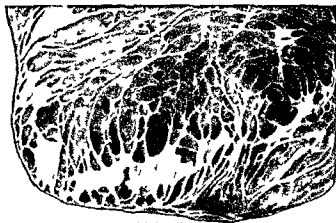


Fig 3 A fibrolipoma developing in the right renal pocket Gyn Path No 31715 The cut surface of the specimen has been stained with scarlet red The fat took the red with avidity, the fibrous tissue was much paler (natural size)

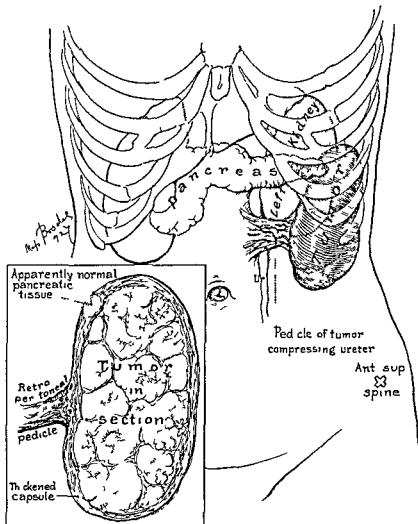


Fig 4 A malignant growth in the left renal pocket, simulating a kidney and apparently from aberrant pancreatic tissue (Schematic drawing made from a sketch furnished by R. Campbell Begg. Later the drawing was submitted to Dr. Begg and proved by him.)

**Operation** April 3, 1926 We made the usual kidney incision commencing about 2 centimeters back of the free end of the twelfth rib and continuing it downward and forward toward the symphysis. We then split the muscles and entered the right renal pocket. The tumor, which was somewhat lobulated, was shelled out. At first we thought that it was the right kidney, but as it was gradually delivered we could feel the normal sized right kidney pushed far up under the ribs. The tumor looked like a lipoma. It was adherent by a dense fascia to the crest of the

ilium. It was entirely extraperitoneal and apparently consisted of hard lobulated fat. After removing the tumor and tying off a few vessels, we opened the peritoneum in the depth of the wound, drew out the cæcum and without difficulty removed the appendix, which was tied down by recent adhesions and which had undoubtedly caused the fever. One cigarette drain was laid in the wound and the incision closed. The child made a most satisfactory recovery and was discharged on April 24, 1926.

*Path report* J H H Gyn Path No 31715

The tumor measures 9.5 by 8 by 7 centimeters (Fig 2). Externally it is yellowish white in color and has a lobulated surface. It is soft in consistency.

On section the tumor is seen to be made up of fat with fibrous trabeculae passing in all directions (Fig 2). All portions of it save the fibrous trabeculae, take the scarlet red stain (Fig 3). The tumor is a typical fibrolipoma.

This is the only case of this character with which we are familiar. We felt almost certain that we were dealing with a right renal tumor and not until we had opened up the right renal pocket did we suspect the fibrolipoma.

After the tumor had been removed it was very easy to cut the peritoneum in the floor of the incision and to deliver and remove

the subacutely inflamed appendix which had given rise to all the symptoms, the indigestion, the localized abdominal pain and the fever. The tumor had occasioned the patient no real inconvenience.

NOTE.—As this short article was going to press R. Campbell Begg of Wellington, New Zealand, told me of a most interesting case that had come under his care.

The patient was a woman 3 years of age. She had a tumor in the left loin which was supposed to be an enlarged kidney. There were no urinary symptoms. The tumor was well encapsulated and had an attachment which passed forward behind the peritoneum. The left kidney was normal (Fig 4). On section the tumor was grayish white with strands of thickened stroma passing through it. There were two or three hemorrhagic and degenerated areas. In the capsule of the tumor at the upper pole was a small piece of typical pancreatic tissue. The tumor itself which was well encapsulated was an adenocarcinoma.

Begg thought that this adenocarcinoma in the retroperitoneal space just below the left kidney was due to malignant degeneration of misplaced pancreatic tissue.



SIMPLE UNCOMPLICATED ROTARY DISLOCATION OF THE ATLAS<sup>1</sup>

BY R. H. JACKSON, M.D., F.A.C.S., MADISON, WISCONSIN

**I**N 1907 Corner drew attention to the fact that rotary dislocation of the atlas is far more common than it is generally supposed to be and emphasized the absence of neurological symptoms or findings in many cases during the early weeks or even months subsequent to injury. In reporting 2 cases of his own and 18 from the literature most of the latter being diagnosed at necropsy and many of them associated with fractures of the odontoid he suggested that cases of simple rotary dislocation were being overlooked. He then gave such a lucid description of the mechanism of the accident and the physical findings that one could not fail to recognize the condition when confronted with a patient so afflicted. Since Corner's article there has been published an increasing number of papers on the subject most of which are single case reports with discussions. From the literature available to me I have been able to collect about 27 cases of simple, uncomplicated rotary dislocation of the atlas.

Shortly after reading Corner's article, we had the opportunity of seeing and recognizing the condition of rotary dislocation of the atlas in a girl aged 11 years since then we have had 3 additional cases. In no instance has the correct diagnosis been surmised by the physi-

cians previously in attendance. When the mind is not attuned to the possibility of the presence of a rotary dislocation of the atlas it cannot be expected to register the correct diagnosis. The general practitioner who as a rule has the first care of the case, very seldom if ever has his attention directed to the subject in the journals which are available to him.

As the title indicates I shall limit my remarks to the lesion of simple uncomplicated rotary dislocation of the atlas, omitting the subject of concomitant fracture or dislocation of other cervical vertebrae except the odontoid process of the axis. My object is to focus attention on the fact that simple rotary dislocation of the atlas is often undiagnosed because it may be produced by accidental violence of such a minor nature that the attending physician fails to conceive of the possibility of its presence. Complications due to the action of more violent forces with resultant associated fractures and additional dislocations present such outstanding features of injury and neurological disability as to demand prompt surgical consultation and X-ray examination which leads to a suspicion at least of the true nature of the lesion.

## MECHANISM OF DISLOCATION

A brief review of the anatomy of the atlanto-axial region recalls the functional limitations of the articulations, clarifies the vision of what may take place when undue strain is placed upon them in an unguarded moment and leads to an explanation of the symptomatology.

The lateral joint surfaces between the atlas and axis are oval shaped and practically plane; these joints are essentially of the sliding or gliding type. Their surfaces are directed slightly downward, forward and outward; those of the atlas resting upon the two oppositely inclined planes of the axis. The capsular ligaments uniting the margins of the articular facets are unusually voluminous and lax. The main function of these joints is to



Fig. 1 (left) Characteristic attitude of the head (Case 1)  
Fig. 2 Deviation of the spine of the axis



Fig 3 Lateral view before and after reduction

permit rotary movements of the occiput upon the axis to a normal extent of 30 degrees (Fig 6)

The tension of the muscles used in rotating the head holds the joint surfaces in apposition and helps to maintain movement within normal limits. Our heads during our conscious states are, so far as these articulations are concerned, held firmly by muscular action. Under deep general anesthesia or at a conscious moment when this guarding muscular action is in abeyance, the head may easily be rotated to the full functional limitation of these articulations, just short of a rotary dislocation. At such a time the unexpected application of force of a nature so minor that it would normally be effectually opposed by the joint guarding muscles, may, owing to the

"flying start" of the head (Corner), result in a rupture of the capsular ligament of one of the atlanto axial articulations and a slipping forward of the articular facet of the atlas onto or over the anterior marginal lip of the facet of the axis. Such is the mechanism producing a unilateral rotary dislocation of the atlas.

#### ANATOMICAL CHANGES IN ROTARY DISLOCATION

In a dislocation of this type there are changes in the relative position of the lateral

#### Normal Odontoid



Fig 4 Same patient after reduction of dislocation



Fig 5 Normal odontoid





Fig 9

Fig 10

Fig 11

Fig 12

Fig 9 Characteristic attitude of the head (Case 1)

Fig 10 Digital pharyngeal examination

Fig 11 Deviation of the spine of the axis

Fig 12 Palpating the transverse process



Fig 13

Fig 14

Fig 15

Fig 16

Fig 13 Modified Binnie method of extension with laparotomy sheet

Fig 14 Extension and counter traction

Fig 15 Manipulation with successful reduction by Binnie method

Fig 16 Application of cast after reduction

dislocation the transverse process may be plainly felt on the side from which the head is turned. On the opposite side the finger sinks in deeply and forward, as the transverse process has in these cases been displaced backward. We have not been able to verify this point, as noted by Corner, in all our cases.

Normally when the head is turned to the right, the right atlanto axial joint is fixed and the left moves, and vice versa. If the left side is dislocated, the head can rotate only a little to the right, the right atlanto axial joint is fixed and the left moves, and vice versa. The chin will point to the side on which the transverse process is rotated backward.

The spine of the atlas is deviated to the side from which the head is bent. The more prominent it is, the more likely is the pres-

ence of fracture of the odontoid with forward displacement of the head.

While in the majority of cases of simple rotary dislocation of the atlas the odontoid process is not fractured or displaced, it is very important to ascertain its condition before manipulative reduction is attempted. This is by no means easily done. At least, in our experience it has not been possible always accurately and definitely to determine its condition by roentgenological studies (Fig 5). As stated above, the odontoid process is as a rule not fractured in the type of rotary dislocation under discussion. Traumatic forward or backward dislocation of the atlas has been considered possible only after (1) fracture of the odontoid, (2) rupture of the transverse ligament, or (3) slipping of the process beneath the ligaments.

**Röntgenological findings** The statement is occasionally made in case reports and in discussions that the true nature of the lesion when suspected may easily be verified by an X-ray examination. This is to be accomplished first by a lateral view which will demonstrate the altered position of the atlas and second by an anteroposterior view through the mouth which will clear up the question of the integrity or fractured condition of the odontoid process. We have found it impossible in any of the 4 cases which we have had to open the jaws sufficiently wide to permit a satisfactory anteroposterior view. The lateral view when clear and decisive satisfactorily reveals the position of the atlas (Fig 3). But in some cases painstaking study is necessary to arrive at even a probable estimate of the condition of the odontoid. As several weeks had elapsed in all our cases between the receipt of the injury and the examination we have assumed when in doubt that the odontoid was intact or reunited.

#### TREATMENT

In view of the fact that successful closed reduction has been made by manipulation several months after the dislocation it would seem advisable even in the absence of direct evidence of injury to the odontoid to delay active attempts at reduction at least 3 or 4 weeks. In the meantime light constant extension by aid of a jury mast weight and pulley, or plaster of Paris cast may be applied. Undoubtedly some of the slighter degrees of rotary dislocation will be reduced by these measures.

When unilateral rotary dislocation of the atlas is present every possible effort should be made to reduce it. When the odontoid process is thought to be intact the majority of writers advocate the administration of a general anæsthetic. In a number of cases spontaneous reduction may occur when the muscles are relaxed. In others gentle traction on the head and rotation will bring about the desired result. Walton called attention to the fact that extension alone or accompanied by rotation, is an inefficient and somewhat dangerous procedure, and advocates first freeing the dislocated articular facet of

the upper vertebra from its position. Whether this upper articular process has simply caught on the apex of the process of the vertebra below, or slipped forward into the anterior notch is a difference only of degree. It should first be lifted free and then rotated into place by dorsolateral flexion followed by rotation.

In our second case the above methods were unsuccessful and we adopted a method used by Binnie with success in a case of dislocation of the sixth cervical vertebra. The patient was placed in a sitting posture on a chair with the head thrust through an opening in a strong laparotomy sheet, the opening in which was so reduced in size by sutures of strong cord that the edges fitted snugly around the base of the occiput (Fig 13). Two attendants standing on operating tables drawn alongside the chair were able as directed to exert very powerful extension on the head. Counter extension was maintained by the hands of other assistants bearing down on the patient's shoulders (Fig 14). At the moment when the extensive force was so great as practically to lift the patient from the chair, the rotary manipulative efforts which were being made at the same time resulted in a reduction accompanied by a click so audible that it could be heard in all parts of the room (Fig 15). This reduction was accomplished without an anæsthetic. We have since used this method successfully in two other cases.

When as must occasionally happen reduction cannot be accomplished by the closed method the question of the advisability of open reduction arises. While it is true that in some unreduced cases the patients seem in time to accommodate themselves to the altered conditions without very evident deleterious effects practically all of the contributions on the subject emphasize the danger of sudden death from an increase in the degree of dislocation, or to the onset of myelitis. In 1906 Corner stated that operative treatment unless to relieve pressure on the cord was not likely to be of much use. In the same year Mixer and Osgood devised and performed an operation in a case of unreduced rotary dislocation of the atlas.

A linear 4 inch incision was made in the median line of the neck and carried down until

the hooked spine of the axis was defined. Next the posterior arch of the atlas forwardly displaced was sought and exposed. With an aneurism needle a stout braided silk soaked in compound tincture of benzoin was passed about this posterior arch between it and the spinal cord. While forward pressure on the anterior arch was exerted through the pharynx traction was made on the posterior arch. There was firm resistance to replacement and only a slight amount of reposition was accomplished. This was maintained, however, and the atlas firmly anchored by tying the silk band about the hooked spinous process of the axis. The patient wore a supporting apparatus for 2 months after the operation and 2 years later was without symptoms other than slight stiffness, and led an active life.

In 1918 my brother, Dr. James A. Jackson, performed successfully an open reduction in a girl 11 years of age, after repeated attempts by extension and manipulation under full anesthesia had failed (Case 1). These 2 cases are the only ones in which open operation was performed so far as I have been able to ascertain from the literature available to me.

#### REPORT OF CASES

CASE 1 (25700) Mrs. H., aged 11 years, came to the Clinic because of pain and stiffness in the neck, with inability to open the mouth beyond a very limited extent. Three months previous to admission, while the child was playing in the school yard an older pupil accidentally ran into her and she was rather violently thrown to the ground, the front and side of her head striking the earth forcibly. The above symptoms appeared immediately. During the intervening 3 months she had been under treatment by the home physician for "sprained neck."

Rotary dislocation of the atlas was suggested by the characteristic position of the head (Fig. 1). On palpation the spine of the axis was found to be more prominent on the side from which the head was turned (Fig. 2) and the transverse process of the atlas was palpable on the side of the dislocation while on the other side it could not be felt. It was not possible to make a digital, pharyngeal examination until the child was under full anesthesia when the characteristic changes in the pharyngeal contour were easily detected. Lateral X-ray plates showed very clearly the dislocated atlas (Fig. 3). The odontoid process appeared intact. No neurological symptoms were present, except the persistent occipital neuralgic pains.

Under general anesthesia every effort was made at reduction without success and as a second at

tempt a week later was also without result. Dr. James A. Jackson devised and performed the following operation. A 1/4 inch linear incision was made from the base of the occiput downward in the median line of the neck. The spine and posterior arch of the axis were exposed, and also before the operation was completed, the posterior aspects of the lateral atlanto axial articulations. Lion jawed bone clamps were applied, one to the spine of the axis and the other to the posterior arch of the atlas (Fig. 20). The operator grasping these clamps firmly, attempted by a process of "wiggling" and rotary motion to reduce the dislocation, dorsiflexion was done during the maneuver by an assistant who also rotated the occiput after the method of Walton. Repeated unsuccessful attempts were made to displace the dislocated facet of the atlas from the intervertebral notch where it was lodged. The operation was about to be given up as futile when during a final trial a loud click was heard. Immediately the stiff non rotating character of the head and neck changed to that of normal rotation. A strong loop of kangaroo tendon was placed around the posterior arch of the atlas and anchored to the spine of the axis to prevent a possible recurrence of the dislocation. The wound healed by primary intention. A plaster of Paris cast embracing the head, neck and upper thorax was applied immediately after the operation and worn for 3 weeks. The child made an uneventful recovery (Fig. 4).

CASE 2 (19167) Mr. W., aged 63 years, came to the Clinic March 29, 1918, with complaint of pain and stiffness in the neck and limitation of rotary motion. On attempting to turn his head he had noticed marked increase in pain and had the sensation of a slight click. This caused intense pain and he had great difficulty in getting his head back to the original position. He had had trouble in eating as he could not open his mouth properly. The symptoms appeared immediately after he fell down 14 cellar stairs 6 days ago. In falling, his left temporal frontal region struck on one of the lateral abutting walls of the areaway. He had been treated for "sprained neck" by home physicians. Inspection and palpation revealed the signs characteristic of a rotary dislocation of the atlas (Figs. 9 to 12).

Lateral X-ray views did not satisfactorily show the condition of the odontoid. The patient was placed in a supporting plaster of Paris cast and kept in bed for 4 weeks. April 27, 1918, the mouth had relaxed sufficiently to permit of pharyngeal, digital examination which revealed the characteristic features of rotary dislocation (Figs. 10 and 8).

Without the use of an anesthetic the dislocation was reduced by the modified Binnie method (Figs. 13 to 16). At the height of the maneuver a loud click was heard and as soon as the patient was lowered to the chair he gave a voluntary exhibition of the return of function of the atlanto axial articulations.

CASE 3 (44601) Mr. D., age 40 years, was brought to the Clinic May 11, 1925 by Dr. Horn of Stoughton, Wisconsin. The chief complaint was pain in

the neck and left side of the face. The attitude of the head and neck and semiclosure of the mouth were so characteristic that as soon as we saw him we were convinced he had a rotary dislocation of the atlas (Fig 17).

Three weeks previously while working with a telephone crew he had been struck on the head with a large swinging block and tackle the blow knocking him a distance of 15 feet. He continued at work the rest of the day but had a great deal of pain and stiffness in the head and neck. That night pain and stiffness increased and he apparently became delirious and for 10 days presented symptoms of concussion of the brain. The pain in the head and neck was so constant and severe he took morphine each day. The chin was turned to the right he was unable to open the jaws beyond the thickness of his index finger and he complained of numbness of the little and ring fingers on the right hand.

The transverse process of the atlas was palpable on the left but not on the right. The palpating finger discovered a decided prominence about the level of the base of the soft palate and uvula more noticeable on the left than on the right with decided depression above and below. It was quite tender and caused pain in the head on pressure.

The X ray findings are shown in Figure 18.

May 19, 1925 reduction was attempted by closed reduction without an anæsthetic as in Case 2. At the height of the maneuvers a distinct click was heard throughout the operating room. The patient was lowered to the chair and immediately cried out.

It's all right Doctor I can open my mouth smiled and went into a semi convulsion followed by deep syncope. A minute or two later he regained consciousness and voluntarily started to rise from the floor only to go off with another semi convulsion ending in syncope. When he recovered from this attack he was kept quiet on the floor for an hour and a plaster-of Paris cast was applied. Convalescence was uneventful. Two months later when Figure 19 was made he still complained of numbness of the little and ring fingers of the right hand.

CASE 4 No 40534. A boy age 17 on July 17, 1926 dove from a pier into shallow water striking his forehead on the bottom. He was momentarily stunned and assisted from the water by his companions. He complained of great pain and stiffness in his neck with inability to open his mouth beyond 3/4 of an inch. He reported to the Clinic the following day and was referred by the physicians who examined him to the physiotherapy department for treatment for 'sprained neck'. Some 4 weeks later Dr J A Jackson happened to notice him and was so impressed by the peculiar attitude of his head that he made inquiry as to the nature of his trouble. The boy had lost 14 pounds since the injury due to inability to open his mouth properly in eating and to difficulty in swallowing.

On examination he presented the characteristic history symptoms and physical findings of a rotary dislocation of the atlas. This was reduced by Dr J A Jackson by the Binnie method without an anæsthetic. There being some question as to whether the reduction was complete an anæsthetic was administered under which full normal rotary movements of the occiput and atlas on the axis were demonstrated. A plaster cast was worn for 3 weeks. After its removal there was so much pain tenderness and stiffness in the entire cervical region for several weeks that it was evident he had sustained considerable trauma to the ligaments and musculature of this region in addition to the dislocation of the atlas at the time of the injury.

#### SUMMARY

Uncomplicated rotary dislocation of the atlas occurs more commonly than is supposed and may easily be overlooked.

If the lesion is not recognized and reduced, it may result in sudden death from an increase in the dislocation or to the development of myelitis months or years after the injury.

Rotary dislocation of the atlas is a distinct clinical entity presenting a characteristic history and symptoms with physical findings verifiable by X ray examination.

The general practitioner who is the one as a rule to see these cases first should learn to recognize them.

Every effort should be made to reduce the dislocation including if necessary resort to open operation.

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## THE URACHUS AND UMBILICAL FISTULÆ

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## ANATOMICAL CONSIDERATIONS

THE following facts are extracted from a study of urachal anatomy, based on a large number of operation and post mortem specimens, made some years ago<sup>1</sup>

In embryos of 10 to 24 millimeters, the bladder, which in its upper part is derived entirely from the ventral cloaca, reaches to the umbilicus. As development progresses, the organ retains the same position, but its upper part or apex narrows more and more and becomes the urachus. The latter is simply the modified superior extremity of the bladder, and owes nothing to the allantois. The research of Felix<sup>2</sup> has established this fact beyond question.

*Descent of the urachus.* At birth the urachus reaches the umbilicus and is attached at its apex by three fibrous strands, one to each umbilical artery and one passing into the umbilical cord. The last is the only remnant of the allantois. Immediately following birth the bladder begins its descent, taking the urachus with it. The latter leaves the region of the umbilicus altogether, dragging the obliterated ends of the umbilical arteries with it and pulling the fibrous tissue of the umbilical scar into a long strand of cord like tissue.

The end result of this process, as seen in the adult, is the following. The urachus, rarely more than 5 centimeters in length, passes up from the anterior wall of the bladder just below the apex. Its upper extremity is fully 11 or 12 centimeters inferior to the umbilicus, but is connected to the latter either by a single cord of fibrous tissue, or more commonly by a series of fine diverging strands which unite at their upper parts. These strands first described by Luschka, and known as Luschka's plexus are derived largely from the adventitia of the umbilical arteries, teased out by the descent of the urachus. The latter, being attached on either side, is itself sometimes torn asunder, and as its canal at

this stage communicates with the bladder in 33 per cent of cases, tiny drops of urine may be liberated into the transversalis peritoneal space and give rise to septic effusions. These are strictly localized between the fibrous strands of Luschka's plexus, and doubtless appear in the literature under the caption of "septic urachal cysts."

## HISTOLOGY OF THE URACHUS

*Obliteration of the urachal canal.* Two features of the urachus are commonly described: (1) that it reaches from the umbilicus to the bladder, and (2) that its canal is obliterated to form a fibromuscular cord.

It can be demonstrated that the first statement is incorrect. Only the pathological or undescended urachus even approaches the umbilicus (Fig. 1). The second will equally fail to bear investigation. The urachal canal remains patent—in part at least—throughout life (Fig. 2).

The following description is founded on an examination of some 70 specimens taken at random from the postmortem and anatomy rooms, and is in essential points in harmony with the observations of Luschka and Wutz, which have been ignored by the writers of most of the current anatomy textbooks.

The adult urachus varies in length between 3 and 10 centimeters, averaging 5 centimeters. The lowest centimeter runs an intramural course in the bladder wall, the remainder lies in loose areolar tissue between the transversalis fascia and the peritoneum. Its apex is connected to the umbilicus by several fibrous bands, one of which is central, the whole forming a musculotendinous apparatus for steadying the apex of the bladder during micturition. Its breadth at the base is 8 millimeters, at the apex, 2 millimeters. It consists of an outer sheath and a central canal. The latter is separated from the sheath by a layer of very loose connective tissue and can easily be dissected free. The sheath is covered externally and posteriorly only by a

<sup>1</sup> Begg R. Campbell. The Urachus. Thesis Edinburgh Univ. 1923.

<sup>2</sup> Felix. Keibel and Mall. Embryology.



serous coat provided by the peritoneum, next a loose areolar, and then a fine connective tissue layer. Internal to this is a layer of muscle derived from the oblique fasciculi of the bladder and within that, one of dense fibrous tissue. The central canal is a white tubular structure of perfectly uniform bore resembling a portion of a small thoracic duct. Its diameter in normal cases is 1 millimeter. It can be traced from the upper end of the urachus and pursues a wavy course especially in its passage through the bladder wall. It can thus adjust itself to the lengthening and shortening which the muscular sheath undergoes when the bladder is functioning. The canal has an outer layer of condensed fibrous tissue and an inner lining of epithelium. *This epithelial lining never undergoes obliteration.* The epithelial cells are in direct contact with the fibrous layer, no basement membrane intervening. The general arrangement is of irregular transitional epithelium. While the epithelial core always presents an unbroken continuity, the lumen of the central canal is subject to interruption by filling with desquamated cells from the inner layer of epithelium (Fig. 3). The lower centimeter of the canal is as a rule patent and a stout bristle can be made to enter it for this distance. Fibrous obliteration, except for a small portion at the upper end, never takes place.

The epithelial cells show a marked tendency to proliferate outward into the connective tissue and form quite complicated adenomata and cysts in most cases, but as this feature is not of importance in connection with the subject of the present article, it need not be further dwelt upon.

*Normal method of termination of the lower end of the urachal canal and its relation to the bladder.* In 33.3 per cent of the specimens examined (Fig. 4) there was free communication between the lower end of the urachal canal and the interior of the bladder (Fig. 5). In the others the canal, though patent in itself, ended blindly just external to the mucous membrane of the organ without actually forming a communication. In some cases the opening into the bladder was placed on a papilla; in others it was at the bottom of a depression. More commonly it was flush with

the surface of the mucous membrane. In several of the cases the bladder mucosa was protruded in the form of a diverticulum between the muscle fasciculi and the urachus opened into the summit of this sacculus.

The method of protection of this weak point in the bladder wall is of interest. The adventitia of the bladder is not prolonged over the urachus, nor do the strap-like longitudinal detrusor muscles contribute any fibers to it. In the moment of contraction of the latter, however, their medial margins come firmly together, forming a strong support in the moment of danger for the opening through which the urachus escapes, just as the levator ani protects the orifices of the pelvic floor.

The lumen of the normal urachus, although always present, is not a possible vehicle for the conveyance of urine except in most minute quantities. Its bore (1 millimeter) forms a very fine capillary tube, and even under great pressure it is impossible to force methylene blue farther than 1 centimeter above this point; the channel is obstructed by proliferated and shed epithelial cells and debris.

#### BLOOD SUPPLY OF THE URACHUS

One of the superior vesical arteries, usually the left, passes up the lateral aspect of the bladder to the apex and then courses along the ventral aspect of the urachus, to which it is closely applied and to which it supplies numerous small branches. This vessel is constant and may be described as the *urachal artery* (Fig. 6 SP). It can be traced to the apex of the urachus and along the allantoic remains as far as the junction of the umbilical cord with the skin.

In cases in which the first part of the allantois remains patent, this artery passes into the cord, causing such an increased vascularization as to prevent the dry gangrene in virtue of which the cord normally separates; the separation fails to take place and the large red tumor which forms such a remarkable feature in cases of congenital urinary fistula is left projecting from the navel.

#### ANOMALIES

The commonest anomaly is where the upper part of the ventral cloaca fails to narrow and

a true functional bladder reaches the umbilicus. In such cases the bladder itself does not descend but remains permanently in this position. Its upper part may narrow considerably, but no urachus in the normal sense is formed. This is the condition present in all congenital cases of umbilical urinary fistula, which are really vesico umbilical fistulæ rather than uracho umbilical.

Ectroversion of the bladder presents a typical picture of non-descent of the bladder, and non formation of the urachus. In these cases, it almost invariably reaches the umbilicus.

#### VESICO-UMBILICAL FISTULÆ

The condition in which urine escapes from the umbilicus has been known for a very long time, and cases are recorded as far back as the middle of the sixteenth century. Two of the most dramatic incidents in the pathological history occurred, when Paget,<sup>1</sup> some 80 years ago passed his finger down through the umbilicus in a man of 40 years and hooked out a ring shaped calculus from the bladder, and when Mikulicz 50 years later, carried out a cystoscopic examination through the navel, in a male child 5 years of age, whose urethra was too small to admit the instrument.

One or two cases, at least, of fistula in the umbilical neighborhood will probably be remembered by every surgeon of experience, but such a multitude of pathological states may give rise to these discharges that a casual review of the literature is apt to give a false impression of the number of instances in which the discharge was derived from the urinary bladder. Even in many of those cases reported in which urine escaped from the umbilicus, a careful study will assign other causes than a patent urachus, and, indeed, false conceptions of the anatomy of this structure have led to the far too frequent assumption that it was the vehicle by which the bladder content was conveyed to the fistulous opening. Two museum specimens may be cited in illustration of this. The first is in the museum of the Royal College of Surgeons, Edinburgh, and shows the kidneys, bladder, and anterior abdominal wall of a female child 8 years old.

The specimen is described as a patent urachus and the case was reported by Caddel.<sup>2</sup>

The child suffered for one year from hæmaturia, followed by great pain, swelling, and hardness of the abdominal wall, and later by an escape of urine from the umbilicus. The discharge consisted of mixed pus and urine. It died from pyelonephritis. Caddel stated that a No. 6 catheter could be passed into the bladder from the umbilicus.

On re-examination of this specimen it was noted in the first instance that the kidneys were lobulated and of the fetal type—a common accompaniment of malformation of the urinary tract, in the second place, that the bladder was very contracted and chronically inflamed, and, in the third, and this is the most important, *the glass rod passed through the navel along the fistulous track did not pass into the bladder at all, but into the space of Retzius between the transversalis fascia and the peritoneum.* In other words, urine escaped from the bladder into this space, and passed up in it until the weak point of the umbilical pit was reached. This was the stage in which the child suffered from pain, brawny œdema, and hardness of the abdominal wall.

This case has been described somewhat fully, because I believe that a re-opening of the urachal canal after the descent of the urachus would, on histological grounds, be extremely unlikely, and, if it did occur, would act as a channel only one third of the way to the umbilicus. A much more feasible explanation of these cases is that the lower end of the urachus, if the canal communicates with the bladder becomes dilated and weakened by pressure or sepsis, or both. It gives way, and a leakage of urine takes place. This outflow is fairly well confined in a linear channel bounded by transversalis fascia in front, peritoneum behind, and the fibrous cords derived from the obliterated hypogastric arteries on either side. The effusion is conducted to the neighborhood of the umbilicus and, limited by the intimate adhesion of the peritoneum to the transversalis fascia at this point, it finally bursts through the comparatively thin partition between itself and the floor of the umbilical depression.

<sup>1</sup> Paget Med. Chir. Tr. 1850 2d ser. xv. 203.

<sup>2</sup> Jahr. Ueber Urachus Fisteln. Beitr. z. klin. Chir. 1900 xxvi. 323.

<sup>3</sup> Caddel F. Fdnb. M. J. 1878 xxiv. 221.

serous coat provided by the peritoneum, next, a loose areolar and then a fine connective tissue layer. Internal to this is a layer of muscle derived from the oblique fasciculi of the bladder and within that one of dense fibrous tissue. The central canal is a white tubular structure of perfectly uniform bore resembling a portion of a small thoracic duct. Its diameter in normal cases is 1 millimeter. It can be traced from the upper end of the urachus and pursues a wavy course especially in its passage through the bladder wall. It can thus adjust itself to the lengthening and shortening which the muscular sheath undergoes when the bladder is functioning. The canal has an outer layer of condensed fibrous tissue and an inner lining of epithelium. *This epithelial lining never undergoes obliteration.* The epithelial cells are in direct contact with the fibrous layer no basement membrane intervening. The general arrangement is of irregular transitional epithelium. While the epithelial core always presents an unbroken continuity, the lumen of the central canal is subject to interruption by filling with desquamated cells from the inner layer of epithelium (Fig 3). The lower centimeter of the canal is as a rule patent and a stout bristle can be made to enter it for this distance. Fibrous obliteration except for a small portion at the upper end never takes place.

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Fig. 2 A cross section of the urachus taken centimeters above the bladder. The central canal lined with epithelium is plainly visible together with the various layers of tissue which surround it (X60).

and 7, moreover it is to be noted that developmental anomalies were present, and in the former these were so gross that the sex of the child could not be determined.<sup>1</sup> That the presence of phimosis has an influence in keeping a fistula open is shown by those cases in which the condition was cured by circumcision alone, but even here it must not be forgotten that the majority have a tendency to spontaneous closure.

*The developmental theory.* The correct explanation of congenital umbilical urinary fistulae should undoubtedly be based on developmental grounds. Before the exact nature of the anomaly concerned is considered it may be useful to tabulate the abnormalities observed in conjunction with the fistula, in the series under review. These are as follows: Patent vitelline duct (20 and 29). Double undescended testicles (18). Fused labia minora, without urethral obstruction (54). Umbilical and epigastric hernia (16, 28, 42, 46 and 47). The remarkable case of Smith (43) in which blood flowed from the fistula at the menstrual period. This may possibly have been due to a horn of the uterus being implicated.

<sup>1</sup> A case of umbilical urinary fistula in an hermaphrodite animal was reported by Rocks in 1912.



Fig. 3 A high power view of the urachus in another subject showing how the proliferation of the epithelium is tending to obliterate the lumen.

It may be noted that while the condition of combined vitelline and urachal fistula is very rare, a case has been reported by Goupil in a boy of 12, who had developed at the age of 9, a combined intestinal and urinary fistula above the symphysis pubis. This probably represented a stage in the production of a true ectopia vesicae and the penis was represented by a small unperforated tumor.

A more fully developed condition in which ectopia vesicae combined with fecal fistula was encountered in a newborn child came under my own observation.

To these abnormalities must be added those already given in which obstruction coexisted, for example, Case 41, malformed genital organs, and Case 7 in which the vesical orifice was occluded by a membrane. In the latter remarkable case reported by Cabrol<sup>2</sup> in 1850, the membrane was punctured with a cannula. The patient, a girl of 18, had an elongated tubular projection at the umbilicus from the tip of which urine was evacuated. Cabrol also dealt with this and was able to report a complete cure at the end of the twelfth day.

How easily false conclusions may be drawn in regard to causation, is illustrated in Cases

<sup>2</sup> Sur un vice de conformation singulière. J. de méd. de Paris 1756, 108.

<sup>3</sup> Alphabet Anatomique. Tournan 1594 p. 99 obs. xx (Rep. Florentin).

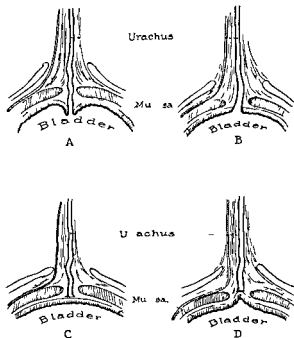


FIG. 4. Four diagrams illustrating the method of termination of the urachus. In *A* and *B* it communicates with the bladder. In *C* and *D* it reaches the mucosa but does not communicate with the lumen.

70 and 29. In both instances a phimosis was present and might have been considered a causal factor if obvious maldevelopment had not been evidenced by the presence of a patent vitelline duct. The 11 cases of abnormality is not likely to represent the total number. The presence of lobulated kidneys, for example, so common in other congenital defects of the urinary tract that come to autopsy would obviously not be recorded in this series though it is in the urinary system that co-existing anomalies would be most likely to manifest themselves.

Consideration must now be given to the exact nature of the conditions present and this involves a further reference to the development of the urachus. This is necessitated by the fact that in a large number of the cases the fistula was not due to a patent urachus at all, in the more ordinarily understood meaning of that term. That is to say, there was no narrow canal leading up from the apex of the bladder to the umbilicus. On the contrary, the opening at the umbilicus led directly into the cavity of the bladder itself,

the apex of which reached as far up as the umbilicus. There was no urachus, and this phenomenon can be understood only on the grounds that the latter organ is developed from the ventral cloaca and not from the allantois, or in other words it is the upper part of the bladder that has been narrowed down the cavity of which has been in many cases shut off to form the urachal canal while in some it remains in communication with the parent organ.

Extracts from the authors from the series of cases being considered bring out this point very well. For example:

**Annandale's case.** In this male of 39 years the urine flowed away from the umbilicus spontaneously when he was lying down. The opening would admit the tip of the finger and a No. 12 English sound passed into the bladder through it without effort.

**Cabbel's case.** Mulatto girl passed urine either by urethra or umbilicus at will in full stream.

**Erdmann's case.** In this 4 year old child a probe passed through the umbilical fistula and waved from side to side like a pendulum showing that it had entered a large cavity. At operation the bladder was found to be fusiform in shape and the urachus which was  $\frac{3}{4}$  inch wide and 3 inches long was apparently continuous with the bladder itself.

**Gerster's case.** The patient was a male aged 52 and the bladder was examined by cystoscopy through the umbilicus. The fundus appeared to be prolonged directly up to the umbilicus.

**Graf's case.** The patient a man aged 28 years had an umbilical fistula at birth which was healed by the use of escharotics. When he was 25 a carcinoma developed and perforated the umbilicus from which urine was subsequently discharged. Although described as a carcinoma of the mucous membrane of the urachus this is much more likely to have been a carcinoma of the bladder whose apex had remained open from birth.

**Hues's case.** Male aged 15. The urine flowed out of the umbilical fistula when he was lying down very little in the day time.

**Jaboulay's case.** Male 62 years. Urinary umbilical fistula at birth. This closed in 15 days spontaneously. Prostatic obstruction at the age of 62 and urine again burst forth from the umbilicus. I have already shown that if the urachus had undergone normal descent after birth no such happening could have taken place.

**Jahn's case.** In this boy of 5 a cystoscopic examination was carried out through the umbilicus. Afterward at operation Mikulicz found that after a course of 3 centimeters the fistulous canal entered straight into the bladder.

**Page's first case.** Female child age 4 months. The skin at the umbilicus was inverted and when it was pulled out urine gushed from the opening.

Paget's second case Male, aged 40 The fistula would admit 2 fingers and the mucous membrane of the posterior wall of the bladder protruded through the orifice No urine escaped in the act of micturition until this mucous membrane was withdrawn by the emptying of the viscus So obviously did this opening communicate directly with the bladder that Paget was able to extract a calculus from that viscus through it with his finger

Pierre's case "Behind the fistula was a discoid cavity from which the urine escaped"

Sterlin's case Female, aged 12 Urine flowed freely from the umbilicus when she was lying down but very little when she was standing The point of the finger could be passed into the umbilical ring A No. 9 (Eng.) bougie passed through it at once and entered a cavity A metallic sound passed through the urethra met this one in the bladder

Tulohsle's case Male aged 52 In infancy urine was passed through the umbilicus but this ceased in the fourth year At 48 without apparent cause, urine again commenced to flow from the umbilicus Operation disclosed that *there was no urachus and the bladder reached to the umbilicus*

These cases clearly show to my mind that in this type of fistula, no urachus is formed at all—the whole of the ventral part of the cloaca going to form the bladder To the apex of the latter the obliterated, or in rare cases possibly the partially open, cord of the allantois is attached, and may pass for some distance along the cord as in Case 20 that Haran observed as early as the year 1648 The child was newly born, and the ligature had included apparently a patent allantois for a cystic dilatation appeared between it and the body wall When this cyst was opened, urine gushed out and continued to flow

In many infants, no doubt, the same anomaly in the development of the bladder occurs, and these escape urinary umbilical fistula, because the line of demarcation by which the cord separates just evades the bladder which is thus not opened Both classes of case are likely to develop urinary fistula if backward pressure occurs in later life—those who have never had one as children, and those whose fistulous opening has closed in the early years of life

A case occurred in the clinic of Sir Harold Stiles of Edinburgh,<sup>1</sup> which will serve to illustrate the non formation of the urachus



Fig. 5 Longitudinal section showing the communication between the lumen of the urachus and the bladder

In a girl aged 15, who had suffered with incontinence all her life, a diagnosis of persistent dilated urachus was made, because the point of a sound passed into the bladder could be palpated at the umbilicus In this case, as proved by examination and subsequent operation, there was no urachus—the bladder itself reached the umbilicus Accompanying this maldevelopment there was a general absence of the musculature of the bladder and urethra, nothing but the thin mucous coat, submucosa and adventitia being present The right ureter was dilated, and the kidneys were lobulated and of the fetal type

The urachus in the horse is a late development and at birth is not present, the cavity of the bladder extending to the umbilicus The process of tearing off the cord thus frequently leads to umbilical urinary fistulae in foals Cullen has collected some interesting observations on this subject, and I would further refer to the article of Nettingan<sup>2</sup> It is thus quite conceivable that many of the subjects of congenital umbilical urinary fistula really show a reversion to an earlier phase in their phylogenic history

<sup>1</sup> A case not unlike this was reported by Torogneau in 1807 in a male aged 9 There was incontinence later no urine passed by the umbilicus

<sup>2</sup> Nettingan Am. Veter. Review New York 1915 xlvii 618

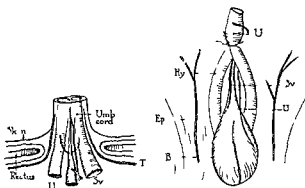


Fig. 6 Schematic drawing to show the general arrangement of the structures about the umbilicus in a full term fetus. Viewed from the peritoneal aspect. B, Bladder; Ep, branches of the epigastric arteries; U, urachus; V, umbilical vein; L, liver; R, rectum; A, aorta; U, umbilical cord. The three strands in which the urachus terminates are well seen in figure at left.

Of course all cases of the condition are not examples of such an extreme lack of urachal development and in many of the 58 cases of the series an actual cord like urachus was found at operation. There are illustrations of imperfect formation of the urachus and as the patent channel is functioning from birth, its epithelium continues to proliferate and the urachus lengthens to keep pace with the bladder descent in virtue of its being a functioning canal.

Such a proliferation does not take place under normal conditions but only when the closure of the upper part of the ventral cloaca is not sufficiently advanced to prevent the urine flowing through it. If the urachus is normally formed it is impervious or practically so no matter what the pressure of the bladder contents. This cannot be better illustrated than by 2 cases side by side for comparison, one Case 41 seen by Preston in 1876 one described by Draudt<sup>1</sup> in 1907. In the former there was complete obstruction to the passage of urine all of which passed by the umbilicus and the child was perfectly well at the age of 2. In the latter there was no external orifice to the urethra, but unfortunately for it the urachus was fully formed and hence practically impervious. The child died on the fourteenth day and sections showed

that the urachal canal at the umbilicus was only 1 millimeter in diameter. This case shows that the normal urachal canal—for this diameter is normal—will not become pervious and dilated whatever the back pressure and that even total urethral obstruction from the earliest fetal days will not produce an umbilical fistula unless the developmental impulse by which the urachus is formed is also in abeyance.

#### CONCLUSIONS

To sum up these observations confirm (1) the view that the urachus is entirely developed from the ventral cloaca and not from the allantois (2) that the bladder is sometimes formed from the whole of the ventral cloaca there being no urachus at all, (3) that the urachus may be very imperfectly developed leaving a wide channel between the bladder and the umbilicus and (4), that if the formation and descent of the urachus follow the normal lines it can never at any future period act as a conduit to convey urine from the bladder to the umbilicus.

#### THE PATHOLOGY OF TUMORS AT THE UMBILICUS ASSOCIATED WITH URINARY FISTULE

A notable feature of this class of congenital fistula is the presence of a tumor at the umbilicus. This occurred in no less than 30 cases in this series. It is described by different authors as resembling a glans penis a nipple walnut a pigeon's egg strawberry, a mushroom etc. In Cabrol's case it was said to be 4 finger breadths in length and was like the crest of a turkey cock. In the remarkable case illustrated and described by Lanzone (Fig. 8) the mother stated that the child had two penises and that it urinated from both at the same time. In this case the appearance was partially due to an umbilical hernia pushing the tumor out. Similar protrusions occur more rarely in Group 2 and every obstetrician is familiar with an occasional instance of a tiny granulomatous excrescence persisting in a normal child after the separation of the cord.

A little consideration will elucidate the cause of this phenomenon. These structures

must be clearly distinguished from the protrusions which precede the outburst of urine in acquired urinary fistula, and their origin is due to imperfect separation of the cord. First consideration must be given to the normal mechanism of separation.

#### PATHOLOGY OF SEPARATION OF THE UMBILICAL CORD IN THE NEWLY BORN

It seems to have to be taken for granted that the cord will separate from the body after birth. Why should it separate? The fact of tying is no explanation as the stump of the cord is still in communication with the living tissue of the body, and the separation takes place just the same whether it is tied or not. That the process is one of dry gangrene with removal at the line of demarcation is of course obvious. The question of the cause of this dry gangrene is bound up in the consideration of how Wharton's jelly and the other constituents of the cord obtain their nutriment *in utero* and what changes take place after the separation of the placenta and the cessation of fetal circulation.

It is difficult to find any allusion to the physiology of Wharton's jelly. Certainly it can live only in a fluid medium, for it dries up when exposed to air, but whether its cells are nourished by permeation from the liquor amni or from effusion of serum from the umbilical arteries or veins has not, so far as I am aware, been considered. Considering the thick coats of the arteries and veins, I think the former supposition is the more probable. Certain it is, that the cord has no direct blood supply from its main arteries or veins, for these give off no branches between the placenta itself and the upper superior vesical arteries in the body of the child.

The umbilical arteries being ligatured an inch or two from the body follow the usual rule in such cases and become obliterated, first by coagulum and then by organization of the clot, as far as the nearest collateral branch—in this case the superior vesical arteries. The vein is obliterated as far as the liver. Wharton's jelly having lost the nutriment supplied by the liquor amni, and the arterial and venous coats being now deprived of the blood in their lumen, no life remains

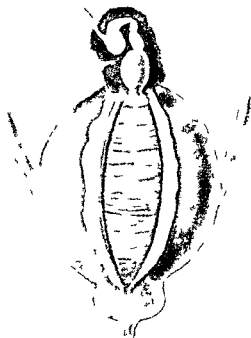


Fig. 7. Dissection of bladder to show the sacculated and beaded urachus passing through the vesical musculature.

in the stump of the cord, and a line of demarcation forms at the skin which is provided with other arterial supply. This is the normal procedure.

#### PATHOLOGY OF CORD SEPARATION IN ABNORMAL CONDITIONS OF THE URACHUS

It has already been demonstrated that the terminal filament of the urachal branch from the superior vesical artery passes along the allantoic remains, and in some instances tracks for a short distance into the cord itself. If the urachus has failed to form properly, because of developmental defect, while the backward pressure *in utero* keeps it filled with urine, it is quite a thick-walled functioning structure, and may bulge into the cord. The allantoic canal itself, may indeed, be filled with urine for some distance<sup>1</sup> and consequently its coats greatly hypertrophied. The net result is that the whole structure requires, and receives an enhanced blood supply from the very vascular area, which sections always reveal in the neighborhood of the umbilicus. This supply is certainly conveyed in large measure by the urachal artery, and its

<sup>1</sup>Witness Haran's Case No. 9.





## TREATMENT

If the condition is congenital, all obstructions such as phimosis and congenital valves in the posterior urethra should be dealt with and the fistula closed by ligature or sutures. This simple procedure was sufficient in the large majority of cases, though there is a danger of reopening should any bladder obstruction develop in later life.

Should it fail, the bladder should be dissected free from the umbilicus, its upper narrow part removed, and the whole brought down to a lower level and either sutured at once or drained and gradually closed.

If the urine is escaping from a normally placed bladder, the fistulous track between this and the umbilicus should be dissected out, the bladder apex freed, repaired and drained per urethram until healing is complete.

## SUMMARY

1 The urachus, in normal cases, does not, as is commonly stated, reach to the umbilicus, but only one third of the way. It is attached to the posterior aspect of the navel by fibrous cords from the obliterated umbilical arteries.

2 Its epithelial canal is never obliterated by fibrous tissue although it is impervious in parts, owing to epithelial debris derived from its own cells. Its lumen is in direct communication with that of the bladder in 33.3 per cent of cases.

3 The lower part of the canal is frequently sacculated in cases in which it communicates with the bladder. This sacculus sometimes ruptures from pressure of urine and the escaped fluid is thus allowed to pass up between the transversalis fascia and peritoneum and discharge at the umbilicus.

4 Normally the urachus descends with the bladder after birth, leaving the umbilicus. Lack of closure of the upper end of the bladder at this time interferes with the descent of that organ. Urinary fistulæ at the umbilicus are frequently vesico umbilical and not urachal umbilical.

5 True congenital fistulæ in which urine is discharged from the umbilicus, and acquired fistula of the same nature are confused in the literature, also cases of true urinary fistula and cases in which a supposed urachal cyst has

ruptured through. The pathology of all these conditions is different.

6 Congenital fistulæ are of two varieties. The first variety includes the cases in which the urine flows freely or perhaps exclusively from the umbilicus. These cases are the result of complete non development of the urachus, the cavity of the bladder reaching the umbilicus. They are easily closed but tend to re open if there is backward pressure in later life. The second variety includes the cases in which the urine escapes drop by drop. These are due to retarded closure of the ventral cloaca to form the urachus. When once cured, the bladder tends to descend naturally and the urachus forms, so that once cured, there is no tendency for the fistula to re open.

7 A urachus which has once descended and assumed normal proportions can never convey urine from the bladder to the umbilicus.

8 It follows that *acquired* fistulæ are of two types. In the first type, through mal development there is no urachus, and the bladder apex is at the umbilicus. This condition is shown by reported cases to have been frequently present. In the second type the urine escapes through the dilated terminal centimeter of the urachal canal, or through the weak point at the junction of the urachus with the bladder. It creeps up in the confined limits of the space in which it finds itself. The peritoneum and transversalis fascia fuse near, at the umbilicus, preventing its further progress, and it bursts through the weak point formed by the depression in the lowermost quadrant of the umbilicus.

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## THE ENCAPSULATED TUMORS OF THE NERVOUS SYSTEM<sup>1</sup>

MEINGEAL FIBROBLASTOMATA PERINEURIAL FIBROBLASTOMATA AND  
 NEUROFIBROMATA OF VON RECKLINGHAUSEN

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THE benign tumors of the nervous system arise in general from the specialized investment which separates and insulates nervous tissue from the rest of the body. They may be divided on histological grounds into three groups. The meningeal fibroblastoma (commonly called dural endothelioma) the perineurial fibroblastoma ('solitary neurofibroma') and the multiple neurofibromatosis of von Recklinghausen's disease. Although the first two are fibroblastic they are easily distinguished from each other microscopically because each retains the morphological characteristics of the specialized connective tissue from which it arises. Only in the last group is nervous tissue to be found.

From a therapeutic point of view the encapsulated tumors form the most important group with which the neurosurgeon has to deal. Of intracranial tumors this group composed chiefly of meningeal and acoustic tumors makes up about 30 per cent of all neoplasms encountered (Cushing 1924.) Among

spinal cord tumors they make up a much higher proportion inasmuch as intramedullary neoplasms are rarer in the spinal cord than in the brain. According to Antoni (1920) the meningeal type composed one third and the perineurial type two thirds in a series of thirty spinal tumors. In Elsberg's experience (1915) however the meningeal tumors were the more frequent in the spinal canal.

Microscopical study of the encapsulated tumors on the part of many investigators has led to a wide variety of conclusions as to their nature and origin. The divergence of these conclusions is demonstrated by the names glioma sarcoma neuroma endothelioma etc.

Study of a series of thirty two of these encapsulated tumors by means of the silver methods of Del Rio Hortega and Cajal in addition to the standard methods has made it possible for the author to demonstrate the intercellular substance with a distinctness which throws light both on the nature and origin of these neoplasms.

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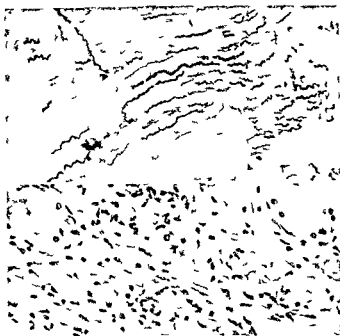


Fig 1 (above) Myelinated nerve fibers entering a neurofibroma (N I 166  $\times 47$  Morgan stain)

Fig Ganglion cells in a neurofibroma with a few subcapsular cells about them. There were two such tumors upon the same spinal nerve root (N I 166  $\times 240$  H & E stain)

#### NEUROFIBROMA OF VON RECKINGHAUSEN'S DISEASE

The multiple superficial tumors which appear in neurofibromatosis are an expression of a system disease which often involves a large number of nerves. The condition shows marked hereditary tendencies (Preiser and Davenport 1918) though patients may present only pigmentary changes of the skin. Thickening of the nerves may be widespread and

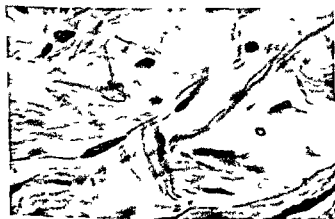


Fig 3 Non myelinated nerve fibers in a neurofibroma. The tumor which was very tender was attached to a nerve in the lateral costal region (P H 10  $\times 648$  silver carbonate neurofibrin stain)



Fig 4 Mixture of connective tissue with occasional nerve fibers to show general structure in a neurofibroma (same case and same stain as in Figure 3,  $\times 366$ )

such a change is said to be the etiological factor in the characteristic pigmentary and hypertrophic alterations of the skin.

The tumors of this disease represent a further development of this thickening process as the fibers proper to the nerve pass through the tumors (Fig 1). This fact led Virchow to divide these tumors into myelinic and amyelinic neuromata depending on whether or not the nerve fibers were myelinated. As Verocay



Fig 5 Area of change to a perineurial fibroblastoma within a neurofibroma. Case of multiple painful tumors on peripheral nerves (P H 200  $\times 213$ , H & E stain)

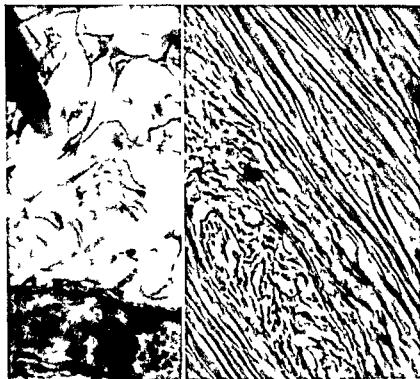


Fig. 6 (left) Detail of one of the degenerative zones in a neurofibroma. The cells probably of the sheath of Schwann seem to be phagocytic and the fibers stain characteristically for nerve fibers. Blood vessel passes through field (I H 141  $\times 3,5$  silver carbonate neurofibril stain).

Fig. 7. Fibers in a perineurial fibroblastoma of the acoustic nerve (VI 188  $\times 1100$  silver carbonate connective tissue stain).

(1908) has pointed out nerve cells are occasionally found in the neoplasms. When present these cells are of adult type provided with subcapsular and capsular cells as in spinal root ganglia (Fig. 2). They are not neoplastic in form and there is no evidence of cell division. Their presence suggests that a congenital abnormality in the structure of the peripheral nervous system is a factor in the appearance of these tumors.

Fibers of the nerve enter the tumor at one end and leave it at the other. Many of them course over the surface but others enter the tumor and stray through it or form a complex tangle with the fibroblastic tissue that is always present (Figs. 3, 4).

Small rarefied areas may be present through which a few nerve fibers pass to be lost in the substance of the tumor. When the nerve fibers are scattered there is much less tendency

to parallelism than there is in a simple amputation neuroma where the growing fibers usually attract to themselves other similar fibers thus forming small fasciculi. The nerve fibers themselves usually appear normal except when they show degeneration. Their behavior however as mentioned above seems definitely abnormal because of the lack of parallelism in the tangled zones.

In addition to nerve fibers however with their sheath of Schwann cells there are a large number of collagen fibers running through the tumor in a tangled mass. These collagen fibers are usually slender and of unchanging caliber throughout like the connective tissue fibers which are found running in the endoneurium of a normal nerve parallel to the nerve bundles.

In view of the presence of connective tissue increase about the fibers of the nerve, it has

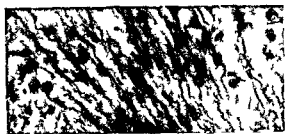


Fig 8



Fig 10



Fig 11



Fig 9

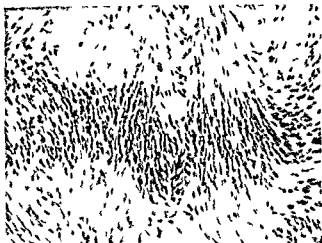


Fig 12

Fig 8 Fibers in a degenerating area of a fibroblastoma of the acoustic nerve (N I 86  $\times 58$ , silver carbonate connective tissue stain)

Fig 9 Fibers between nuclear palisades in a perineural fibroblastoma of a spinal nerve root (N I 7  $\times 582$ , silver carbonate stain)

Fig 10 Fibers between nuclear palisades in a fibroblas-

toma of a spinal nerve. The tumor was extradural but within the vertebral canal (N I 199 about  $\times 1014$ , silver carbonate connective tissue stain)

Fig 11 Nuclear palisades in same tumor as in Figure 10 ( $\times 240$ , H & E stain)

Fig 12 Palisading of nuclei in fibroblastoma of acoustic nerve. Same case as in Figure 7 ( $\times 154$ , H & E stain)

been suggested by Trotter (1926) that these tumors make their appearance because of a lack of proper insulation of the nerve fibers

themselves with a resultant stimulation of connective tissue. He suggests that nervous tissue is normally insulated by specialized



Fig. 13 Degenerating and cystic areas in a perineurial fibroblastoma of a spinal nerve root (NI 151  $\times 15$  Mallory phosphotungstic acid stain)

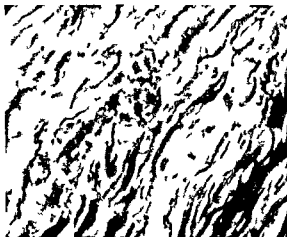


Fig. 16 Collagen fibers in meningeal fibroblastoma of spinal meninges (NI 77  $\times 880$  silver carbonate connective tissue stain)

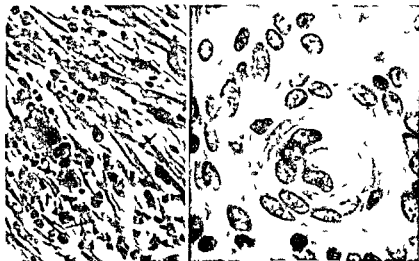


Fig. 14 (left) Fat-laden phagocytes in degenerated area of perineurial fibroblastoma of acoustic nerve (NI 159  $\times 30$  silver carbonate and scharlach R stain)

Fig. 15 Whorl in meningeal fibroblastoma from spinal canal (NI 167  $\times 990$  H & E stain)

cells and that when this insulation is inadequate the nervous tissue acts as an irritant. Unfortunately it has not been possible so far to demonstrate the lack of proper insulation histologically, although Herxheimer and Roth had previously maintained that the pathological process involved was a dystrophy or hyperplasia of nervous tissue resulting from the weakness of some specific element and that the connective tissue growth was in the nature

of a reaction. Whether this is the proper explanation or not, there is always a large amount of connective tissue in these tumors so that von Recklinghausen considered them to be always fibromata.

Because of this varying intermixture of nerve fibers with connective tissue, the time honored term *neurofibroma* is descriptive in the sense that it is a *fibroma* on and in a nerve, the fibers of which contribute toward the



Fig. 1. Meningeal fibroblastoma from parietal region. Note change from rounded nuclei to more elongated fibrous cells. This is not in vicinity of dura (P H 48 about  $\times 150$  H & E stain)

formation of the tumor. If a tumor be called a true neuroma the inference is that it contains nerve cells. Such tumors arise from the sympathetic nervous system and are rare (Bruns, 1908).

A part, sometimes a large part of a neurofibroma may resemble the solitary tumor of the nerve sheath (perineurial fibroblastoma) which will be described below. Such tissue contains the eddies of cells and the palisading of nuclei (Fig. 5) so typical of these latter tumors and few or no nerve fibers.

This fact led Antoni (1920) to call such tumors mixed (neurinoma and connective tissue), while to the solitary tumors he gave the name neurinoma after Verocay's classification (1910). Such zones of fibroblastic change probably arise from the endoneurial connective tissue as the result of some type of

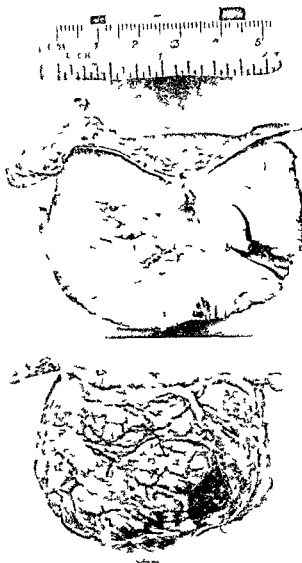


Fig. 1b. Meningeal fibroblastoma showing cut surface above and capsule below. Note small point of attachment to under surface of dura; vessels running in the capsule and central softening (P H 45)

irritation. Thus fibroblastoma may be found occasionally in a pre-existent neurofibroma or even on thickened nerve.

It is also true, however, that multiple meningeal fibroblastomata are found in cases of von Recklinghausen's disease, an occurrence difficult of explanation and for that matter concomitant gliomata and carcinomata have occasionally been reported in these cases. Sarcomatous degeneration of neurofibromata is not an infrequent occurrence which is a further evidence of the mesodermal character of the original reaction.

In retaining for the tumors of von Recklinghausen's disease, the time honored name of neurofibroma, the term must be understood





Fig. 19 (left) Perineurial fibroblastoma of spinal nerve root cut across to show multiple foci of degeneration and cyst formation (NI 163)

Fig. 20 Neurofibromata of peripheral nerves from a patient who presented multiple painful subcutaneous tumors. Note thickening and tortuosity of the nerves (I H 141)

to signify a tumor which contains both nerve fibers and connective tissue. It is not a new growth of nervous tissue although there are nerve fibers and apparently new nerve collaterals running in it. It is not a simple fibroma but a fibrous connective tissue reaction that is part of a more general process.

*Degeneration* is of common occurrence in neurofibromata. Large areas of gelatin like, translucent tissue may be present at the central portion of the tumor without the formation of a cyst.

There are often present in such zones loose star shaped or elongated cells resembling cells seen in myxomatous tissue. Small areas of degeneration may also appear and in them macrophage like cells applied to scattered fibers which may perhaps be degenerating nerve fibers (Fig. 6).

These cells have at times a superficial resemblance to neuroglia astrocytes but they do not form perivascular feet (Fig. 6) and they do not stain by the supposedly specific astrocyte methods. Neuroglia of the central nervous system was not found present in these tumors.



Fig. 1 Recurrent fibrosarcoma of neck. Contrast the orderly arrangement of collagen fibers with that seen in perineurial fibroblastomata e.g. Figure 7 (NI 10 silver carbonate connective tissue stain)

#### PERINEURIAL FIBROBLASTOMA—NEURINOMA, SOLITARY NEUROFIBROMA, GLIOME PÉRIPHÉRIQUE ACOUSTIC NEUROMA ETC

By perineurial fibroblastoma is meant the solitary encapsulated tumor which is found attached to spinal nerve roots, cranial nerves or peripheral nerves. In contrast with the neurofibromata which are most frequently peripheral the perineurial fibroblastoma is commonly found in a central location. Thus they are frequently encountered within the cranial cavity where their attachment is usually to the acoustic nerve or in the spinal canal where the point of origin is a nerve root, usually a posterior root. They also occur though rarely on other cranial nerves especially the optic and trigeminal as well as on peripheral nerves.

Perineurial fibroblastomata have been frequently called gliomata particularly by recent workers in France (Roussy, Lhermitte, and Cornil, 1924). The supposition that these tumors are gliomata rests largely upon the assumption that they arise from the sheath of Schwann cells (Verocay) which are believed to be of ectodermal origin (Harrison, 1924). Cushing (1917) called these tumors as they appeared on the eighth cranial nerve, acoustic

neuromata or neurinomata, stating that they probably represented a transition between neuroglia and connective tissue

As will be pointed out below, the fibers produced in these neoplasms show that the type cell bears no relation to neuroglia nor to the ectodermal sheath of Schwann cells. The histological picture is characterized by palisading and parallelism of nuclei and a tendency to form nuclear eddies and streams. The nuclei are usually elongated and often irregular. They may be large and fat, however, and contain condensations of chromatin which resemble the nucleoli of nerve cells, especially in degenerating areas.

The fibers which are formed can be particularly well stained by silver carbonate. They are typically long, slender, wirelike, and arranged parallel to each other (Fig. 7). These fibers resemble the connective tissue seen in normal nerves where they run parallel to nerve fibers. They are seen especially well in traumatic neuromata where their number is increased. Similar fibers are a varying constituent of other types of connective tissue. They may be stained selectively in the walls of blood vessels and sometimes in the broader collagen ribbons of various fibrous structures where they seem to be differentiated out from the rest of the collagen.

In perineurial fibroblastomata, however, this type of collagen fiber is almost the only one seen. This fact probably explains why the ground substance of these tumors, though taking a color characteristic of connective tissue, stains less deeply than other types of connective tissue with Van Gieson's method or with Mallory's aniline blue. The fibers show no dilations nor end bulbs as would be expected were they nerve fibers. Also there are no cells upon them which may be considered sheath of Schwann cells. The fibers are irregular and broken in the presence of degeneration (Fig. 8).

In the zones between the palisades of nuclei, there is thickening and increase in number of the fibers so that in a good stain one gets the impression that the palisading is of the fibers (Figs. 9, 10) while in a hematoxylin and eosin stain (Figs. 11, 12) the palisading seems to be of the nuclei.

Some of the perineurial tumors have a rather lax structure when *degeneration* is taking place. In such tumors the neoplastic fibers tend to be broken, irregular, tangled and less closely packed together (Fig. 8). The stroma is made up of blood vessels, although in reality the neoplastic cells themselves provide the supporting structure for these tumors. The blood vessels may be possessed of well formed walls which often undergo thickening and closure or there may be no vessel wall except for an incomplete endothelial lining. Heaping up of endothelial cells such as occurs in gliomata is not typical of these tumors. As is well known they are not infrequently cystic and the cysts may be found at the periphery as well as at the center of the growth.

In the more degenerated type of these tumors, cells may be found which suggest neuroglia at first glance. However, specific stains such as Cajal's gold chloride sublimate as well as Mallory's phosphotungstic acid method do not show any neuroglia cells and none of these degenerating cells show vascular processes or footplates, an invariable characteristic of neuroglia astrocytes. Moreover, the formation of the long parallel fibers is entirely foreign to the growth characteristics of astrocytes.

Nerve cells have been reported in these tumors also. In some cases this was certainly due to the mistaken impression that the nucleolus occasionally seen in the tumor cells indicated that they were neurones. On other occasions the tumor was probably a neurofibroma and the case really was one of von Recklinghausen's disease. (Councilman, 1917 reported that he had found nerve cells in two of a long series of cases with acoustic tumors.)

Specific stains do not show nerve fibers in these tumors, and the fibers which are present when stained by other methods do not resemble nerve fibers normal or pathological. The nerve or nerve root to which the tumor is attached may be found at the periphery of the tumor running on or in the capsule and at times a spinal root ganglion itself may be dragged out by the nerve root and flattened over such a fibroblastoma.

Mallory (1920) in a careful histological study of the type cell of the so called dural endothelioma suggested that the fibroblast was the type cell of the nerve sheath tumor as well as of the 'endothelioma'. He therefore proposed the name 'perineurial fibroblastoma' assuming an origin from the connective tissue which surrounds the nerve. Inasmuch as we have found that the fibers in these tumors are *not neuroglial and not nervous in nature but represent a particular form of collagen it is obvious that we must confirm Mallory's opinion provided the neurofibromata be excluded from the group*.

The perineurial fibroblastoma must be considered to arise from the perineurial or endoneurial connective tissue which invests nerve fasciculi and fibers. The intercellular substance formed by these neoplastic cells resembles that found in the connective tissue of the nerve itself. Although fibroglia fibers may be found in these tumors in small numbers as pointed out by Mallory (elastic tissue fibers being absent) the collagenous fibers described above are the outstanding feature from a histological point of view. Their length and arrangement probably explains the parallelism so common in the nuclei of these neoplasms. Palisading of nuclei may likewise be explained perhaps by the local thickening and the increase in number of the fibers which run between the nuclear palisades although the cause for this local fiber hypertrophy must still be left an open question.

*Degeneration* is a frequent occurrence, especially in the perineurial fibroblastoma of the acoustic nerve. This may be manifested in a more lax arrangement of the tissue as in Figure 8 or there may appear patches of circumscribed degeneration where cell elements have disappeared with the formation of small multiple cysts containing fluid (Fig. 13). The line of division between well nourished cells and cysts is apt to be a sharp one and the cyst walls as seen in the gross are smooth and shining.

In spite of such cysts the remainder of the tumor may be quite vascular while macrophages laden with fat droplets may be numerous (Fig. 14).

#### MENINGEAL FIBROBLASTOMA—DURAL ENDOTHELIOMA, PSAMMOMA, MENINGIOMA, ARACHNOID FIBROBLASTOMA

These tumors are always found to be attached to the dura. They never invade the brain or spinal cord but expanding within a capsule displace nervous tissue. They not infrequently, however, infiltrate the overlying skull (Cushing, 1922, Penfield 1923 a, Phemister 1923). During this invasion they cause the bone to he up and form an exostosis.

These meningeal neoplasms resemble histologically psammoma granulations from which they apparently develop in the dura (Schmidt, 1903). In the cytological study mentioned above Mallory showed that the "type cell" of the dural endothelioma lays down fibroglia fibers although in the more rapidly growing area none of these fibers are present. He consequently proposed the name of "arachnoid fibroblastoma." Elsberg (1925) pointed out that in the spinal cord these tumors are sometimes attached to the dura but have no attachment to the arachnoid making it probable that in such cases they arise from cells on the under surface of the dura which correspond to those opposed to them in the arachnoid.

We have been able to stain fibroglia fibers in all of the meningeal tumors. Difficulty was experienced in one specimen which was a very rapidly growing tumor attached to the cerebral dura and which contained an occasional mitotic figure. But on the border of a degenerated area in the center of the tumor neoplastic cells were at last found which had laid down fibroglia fibrils. Such fibers may be stained in the whorls (Fig. 15) which are so typical of these tumors and in the slowly growing cases even collagen may be found (Fig. 16) which is distinct from the collagen of the stroma. In contrast with the neurofibromata and perineurial fibroblastomata these tumors possess a distinct *stroma* which is continuous with the dura mater and contains blood vessels derived from the dura.

The neoplastic nuclei are usually fat and oval and often arranged in columns or more typically whorls (Fig. 15) which may have as their center a collagen fiber, a small vessel or nothing discoverable. Small calcium con-

cretions often appear in whorls or elsewhere in the tumor (psammoma bodies or corpora amylacea)

Palisading of nuclei is sometimes seen and occasionally a very definite transition from the cell typical of the meningeal tumor with fat nucleus and voluminous cytoplasm, to the fibrous elongated cell with slender nucleus suggestive of the perineurial fibroblastoma (Fig 17) Such areas of transition substantiate the close relationship of these two types of tumors but the slender parallel collagen fibers (Fig 7) which are characteristic of perineurial fibroblastomata are absent in meningeal fibroblastomata, or represented in them by a very different type of collagen (Fig 16)

The origin of the meningeal tumors has been discussed elsewhere (Penfield, 1923 *a* and *b*) and will not be treated in detail at present It is sufficient to state that the evidence indicates that they arise from the specialized connective tissue cells of the arachnoid membrane As mentioned above, there may be no demonstrable attachment of the arachnoid *Meningeal fibroblastoma* seems therefore, a better name than "arachnoidal fibroblastoma" as employed by Mallory Such a term indicates its identity with *dural* endotheoma and with the *meningioma* of Cushing but signifies the tumor is fibroblastic as pointed out so clearly by Mallory These fibroblastomata do not arise in the pia-arachnoid at the depth of the fissures but only at points where arachnoid and dura impinge, developing there from the ingrowth of arachnoidal cells within the dura Finally, in view of the *common development* and late differentiation of pia arachnoid and dura mater, the term meningeal fibroblastoma seems to satisfy every requirement

#### GROSS CHARACTERISTICS

A comparison of the three benign encapsulated tumors as they appear in the gross is of practical importance

At operation the meningeal fibroblastomata are attached to dura and are usually dark red or brown in color though after fixation they are white They are rounded, nodular, and firm, and tend to soften and degenerate only at the center (Fig 18)

The perineurial fibroblastoma is attached to a nerve and is usually brown or yellow less often having a reddish tinge than the meningeal tumors The acoustic perineurial fibroblastomata are almost always yellowish and usually degenerated These perineurial tumors, like the meningeal fibroblastomata, are also rounded nodular and firm but degeneration in them may take place not only at the center, but also in a patchy manner at the periphery with the resultant formation of small, smooth walled cysts filled with fluid (Fig 19) In the spinal canal they tend to bleed more at removal than do the meningeal fibroblastomata (Elsberg, 1925)

The neurofibromata, likewise attached to nerves, are rounded nodular, and firm but they are in general whiter, less vascular, and often almost translucent (Fig 20) On cross section degeneration is frequently seen but this results in a transparent jelly-like substance quite different from the degenerative cysts of perineurial tumors or the softening in meningeal tumors Fat granular cells are generally absent in neurofibromata though common in the degenerative areas of perineurial fibroblastomata

#### CONCLUSION

Finally, the benign tumors of the nervous system comprise three chief types (1) meningeal fibroblastomata, (2) perineurial fibroblastomata, and (3) neurofibromata The protoplasmic differentiation of the cells of each type reflects the characteristics of the tissue from which each is derived

Meningeal fibroblastomata lay down collagen only when the whole or a part of the tumor is slowly growing The collagen then is in the form of broad fibers irregular in shape Under such conditions fibroglia are also formed The tendency to form whorls and psammoma bodies resembles the cell structure of arachnoid granulations which normally penetrate the dura

The perineurial fibroblastomata arise from the connective tissue sheath about nerve roots and nerves This connective tissue, being specialized in a somewhat different direction from the arachnoid, normally forms long slender, collagen fibers which seem to lend tensile

strength to nerves. The outstanding characteristic of these tumors is the presence in them of just such long, slender parallel fibers so well demonstrated by silver carbonate.

The presence of these fibers necessitates the characteristic arrangement of the nuclei in streams and eddies, and even in palisades when there is localized crowding of the fibers. At the site of such crowding of fibers which seems to be due to crossing or impingement of two bundles of fibers there is scarcely room for nuclei. Palisading is not pathognomonic however as it is occasionally seen in myomata or myosarcomata where also there may be parallelism of long fibers to form bundles.

In contrast with the rather orderly arrangement of these two types of fibroblastoma most fibrosarcomata encountered present a disordered arrangement of intercellular fibers and also consequently of the nuclei (Fig. 21).

Finally a pure neurofibroma is in one sense not a neoplasm at all. There are wandering nerve fibers derived from the involved nerve and a surrounding tangle of reactionary connective tissue which is a magnification of the widespread pathological alteration of nerves in this system disease. Confusion arises from the fact that at times within these neurofibromata perineurial fibroblastomata may appear and may grow so large as to displace most of the neurofibroma tissue to the periphery. In the cases of von Recklinghausen's disease however nerve fibers will be found to enter each tumor with few exceptions while in solitary perineurial fibroblastomata the

comparatively normal nerve is invariably applied to the capsule of the tumor without penetrating it.

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## ENDOCRINE CAUSES OF STERILITY IN WOMEN

THE DIAGNOSIS, PROGNOSIS, AND TREATMENT<sup>1</sup>

By ROBERT T. FRANK, A. M. M. D. F. A. C. S., NEW YORK

LET me beg your indulgence, because I am bringing before you a subject which is still in the making and therefore may require considerable alteration and revision before final conclusions can be drawn, and because I am promising you a panacea for certain cases of sterility, although the actual drug is not yet ready for human application.

Women mated to sterile husbands, as well as those with mucopurulent endocervicitis or closure of the tubal ostia, are excluded from my discussion. This leaves about 20 per cent of patients, in my material, in whom 3 year sterility must be accounted for on some other basis.

As I am devoting especial attention to this particular type of sterility, my material probably contains more than the average number of these cases. It must be remembered that most sterility is due to gonorrhoea, which on the one hand produces the 30 to 50 per cent of male sterility referred to above, and on the other, causes the cervical and tubal infections which represent 70 to 75 per cent of the female sterility. A small number of cases of secondary sterility may be ascribed to the damage done by unclean or injudicious instrumentation, usually performed in the attempt to produce abortion.

It must also be remembered that the sterility which accompanies the more serious endocrine diseases, saves the world from harboring an undue number of handicapped offspring.

In only a small number of this group is any evidence of systemic disease discoverable. The majority present the appearance of approximately normal individuals, and close examination is needed to discover possible causes for their infertility. Moreover, in the majority, the sterility is not absolute and may be influenced by uncontrollable and often incalculable factors.

## DIAGNOSIS

We all have in mind the picture of the normal, fertile woman, but our conception of normality must be sufficiently elastic to include the long and the short, the thin and the fat, the dark and the fair, the stolid and the nervous. When deviation from type is excessive then only should significance be ascribed to it. The commonest deviations of the general habitus encountered are the long-limbed eunuchoid woman, the florid, hirsute hoarse-voiced masculine one, and the short obese, dull-complexioned scanty haired female. And yet none of these deviations, even when well marked, can be regarded as absolute bars to conception as every physician with extensive experience has learned to his chagrin, if he has been incautious enough to put himself on record in too categorical a fashion.

More definite signs of endocrine disturbance ascribable to individual glands, such as acromegalic facies and extremities, signs of exophthalmic goiter, pigmentation and lassitude referable to hypo adrenalism, to mention only a few of the most striking, are of more serious significance and should be evaluated according to the gravity and prognosis of the underlying disease of the affected endocrine gland. But let me warn you against ascribing every human ailment, defect, and frailty to some vague, often "polyglandular" endocrine disturbance upon the most flimsy evidence.

In most instances, more reliable signs can be obtained by examination of the secondary sex characters (voice, fat, and hair distribution, configuration of breasts and pelvis, psyche), together with a study of the pelvic organs. In so doing, I have, at first subconsciously, but now advertently, grouped my patients into four types to which the vast majority conform: (1) the typical, normal feminine, (2) the infantile, (3) the neuter, and (4) the pseudomascuine.

<sup>1</sup>Read at the Clinical Congress of the American College of Surgeons Montreal October 28 1926

1 The normal type I desire to put myself on record as convinced that women with anteversion and anteversion of the uterus should be classed as normal unless the condition is accompanied by signs of infantilism such as short fornices and short sacro uterine ligaments. Patients in the physically normal feminine group should be given careful examination to exclude cases of overlooked infection and mechanical barriers.

2 Infantilism is evidenced to a greater or less degree by the presence of at least several of the following abnormalities—high symphysis, narrow subpubic arch, slender pubic rami, undue prominence of the vestibular area, thickness and rigidity of the perineum, short or undeveloped vaginal fornices, small portio, long and narrow supravaginal cervical segment, a slender and flabby corpus uteri (although this condition of the uterus may be transitory, because it is influenced directly by the ovarian function) and short inelastic sacro uterine ligaments. Such deviations as convolution of the tubes and changes in the consistency and shape of the ovaries are not determinable with accuracy by pelvic palpation. The infantile women are often attractive, petite, vivacious, neurosthenic and poorly resistant to infection; they will impress the superficial observer as normal specimens of womanhood.

3 The neuter type almost invariably shows insufficient development of the feminine secondary sex characters and may or may not additionally manifest signs of infantilism. The pelvis has a marked narrowing of the subpubic arch, heavy bones, prominence of the tuberosities and not infrequently a general contraction of all measurements. The uterus most commonly is small, often anteverted or retroverted, the sacro uterine ligaments short and inelastic. Even to superficial observation this group appears "subfeminine" if I may be permitted to coin this word.

4 In the pseudomale type a heavy boned pelvis projecting sacral promontory, hypertrichosis, male distribution of pubic hair, cyanosis of the labia, hypertrophy of the clitoris, retrodisplacement of the entire vulva downward and backward are most often in evidence. The internal genital tract may be

perfectly normal. Not infrequently the libido is excessive and yet these individuals are commonly sterile.

So much for the recognition of anatomical evidence of these endocrine types of infertility.

Turning now to the functional abnormalities and to the subjective signs complained of by these groups it is striking that Group 1, the typical normal female, suffers from no abnormalities. Except for an as yet unknown and largely supposititious biological factor we have not even a tenable hypothesis with which to cloak our ignorance. The incompatibility of blood groups of husband and wife has proved illusory. However, this group is numerically small.

The functional signs of disturbances in Groups 2 and 3, namely the infantile and neuter, usually show themselves in scanty menstruation, amenorrhœa and dysmenorrhœa. In Group 4, the masculine type, excessive bleeding of both the menorrhagic and metrorrhagic form may be met, also the menstrual function may be entirely normal. I see no reason to ascribe much importance to the presence or absence of libido, as some German writers, particularly those who are influenced by Freudian doctrines, are inclined to do, because sex feeling is developed under the influence of such variable factors as technique, compatibility, alcohol, time of menstrual cycle, etc. and when well established, it is usually not affected by double oophorectomy.

#### PROGNOSIS

A valid prognosis is difficult to arrive at. Fixed bone changes characteristic of the neuter state or of infantilism, offer the poorest outlook. The prognosis if any endocrine disturbance is present is influenced by the prognosis of the underlying disease of internal secretion and the susceptibility of this disease to therapy or self rectification. Today, especially when the attempt is being made to evaluate the importance of scanty menstruation or amenorrhœa, the investigation of the amount of female sex hormone circulating in the blood is proving of increasing value to me. If the hormone is not demonstrable within a period of observation extending over

5 weeks, the prospect is discouraging. A full description of the method of demonstrating the hormone has been published (1). The prognosis is also influenced by the response of the individual to general hygienic measures.

#### TREATMENT

The treatment is, on the whole, with very rare exceptions, most unsatisfactory.

Obese patients are reduced by diet and more rarely, by carefully supervised thyroid cures, those whose basal metabolism is normal are refractory to such treatment.

Individuals with flabby musculature, low blood pressure, giving the impression of subnormality, must be improved by every roborant measure available. Under modern conditions, which necessitate burning the candle at both ends, including the entire gamut of social visits, athletics, night life and tobacco, the patients' activities must be restricted. Sun baths and quartz lamp treatment, together with rest cures and overfeeding should be tried out, but not persisted in to the extent of producing hypochondriasis.

The sex life should be thoroughly investigated, but in the fewest instances is psychornalysed indicated. Over indulgence is frequently found, because the uninstructed believe that the likelihood of fertilization is dependent upon the frequency of opportunity.

Local treatment today is in its infancy. The attempts to improve the local nutrition of the uterus by means of stem pessaries is based upon the fallacious theory that the functional value of the uterus is solely dependent upon the amount of musculature it possesses. It should be recognized that its muscular development and turgescence under ordinary conditions are an indicator of the degree of ovarian activity.

Recently attempts to stimulate the ovarian function by means of small doses of X ray applied to the ovarian region have been tried with a certain degree of success. It must be borne in mind that radiation is a double edged weapon, the difference between stimulating and depressive doses not being great, and that if the ovarian function is definitely on the decline, even small doses of radiant energy may extinguish it completely.

Finally, the stimulation of the ovarian function by means of the female sex hormone is still in its infancy but is becoming more and more promising. We were able to show that the immature and inactive ovaries of infantile rats could be stimulated and made to become functional and remain cyclical by means of the exhibition of the female sex hormone (2). The product at present available for this therapy in the human female still awaits completion because of the difficulty of purification as well as stable preservation of this hormone. However, I am firmly convinced that the next few months will put in our possession this potent and invaluable weapon against sterility. It should prove of sovereign value unless infantilism or eunuchoidism of the sexual tract are of such a degree that the handicapped individual cannot respond to this specific hormonal influence. I am not sure that the masculine type will respond to the hormone treatment, and must leave this question open for the time being.

#### SUMMARY

1. The non-mechanical types of sterility in the female are due to a general systemic or a local form (or in many instances, a combination of these two forms) of underdevelopment of "feminineness."

2. The diagnosis is based upon the changes that are found throughout the organism, and locally.

3. According to the conditions present, women may be grouped as typical (normal feminine), infantile, neuter, and pseudo masculine.

4. The prognosis is based upon the number of anatomical stigmata, the co existence of endocrine diseases, the presence or absence of the female sex hormone in the circulating blood, and the response to general hygiene.

5. The treatment is divisible into general and local. Under general, I emphasize restricted diet and thyroid substance for the obese, roborant measures and overfeeding for the hypoplastic, for both groups, hygiene of the social life and control of the sex life. Under local measures, we have noted stimulation of the ovarian function by means of the X-rays in rare instances, and the promise of an



efficient hormone preparation in the very near future

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## HYDROCELE OF THE TUNICA VAGINALIS

### A STUDY OF FIVE HUNDRED AND TWO CASES<sup>1</sup>

By MEREDITH F CAMPBELL MD NEW YORK

Att d g l o g i t l a n l a a d B e o d S t t H o s p i t a l A t t a t i v i t Surgeon C a r l o s t i t  
A d j u c t l o g i s g r o n B l l e u e

OF the tumors associated with the male reproductive tract hydrocele is commonest. Infection and trauma are chief of the known causes. The diagnosis is usually correctly made but may be extremely difficult or even impossible. Treatment is surgical relatively simple and generally known. Postoperative complications may be alarming especially the loss of the testicle. In recent years no thorough study of a large series of hydroceles has been reported. The periodic occurrence of disturbing postoperative sequelae led us to an analysis of 502 hydroceles of the tunica vaginalis presented by 456 patients and operated on by 79 different operators. These patients whose ages range from 6 weeks to 81 years were admitted to Bellevue Hospital from January 1919, to March 1926. Thirteen cases in infants are included from the Children's Surgical Service of Bellevue Hospital by courtesy of Dr Carl G Burdick, Director; all other cases were treated on the Urological Service. In this study we were particularly interested in etiology, treatment, complications and end results. We report also observations on the duration of the disease, symptomatology, diagnosis and period of hospitalization.

### ETIOLOGY

**Anatomy.** Hydrocele is an abnormal accumulation of serum in some part of the serous pouch (processus funicularis) which precedes the testicle in its descent and in which the testis and epididymis are invaginated. By

this invagination there is formed the scrous covering of the testes (tunica albuginea) and the parietal serous layer lining of the scrotal cavity (tunica vaginalis). Normally the testes are protected by a few drops of fluid within this cavity. Failure of the peritoneal funicular process to become obliterated throughout its course from the internal inguinal ring to a point just proximal to the epididymis permits a variety of abnormalities, particularly hydrocele and hernia formation. So called hydrocele is occasionally encountered in the female most frequently in the canal of Nuck as an embryonic anomaly and is usually diagnosed as hernia.

Hydroceles have been classified according to location (Jacobson) as

#### I Hydrocele of testes

##### A Within the tunica vaginalis

- 1 Ordinary
- 2 Congenital
- 3 Infantile
- 4 Inguinal

##### B Encysted of testes and epididymis

#### II Hydrocele of the cord

##### A Diffuse

##### B Encysted

#### III Above complicated by hernia

#### IV Hydrocele of hernia sac

These various types are schematically shown in Figure 1. Congenital hydrocele in the sense that the condition was present from birth was noted 15 times in this series 10 of which were in infants. In but 3 of the adults however was hydrocele of the true congenital

type reducible Hydrocele of the cord was recognized but 4 times All others were classified as of the tunica vaginalis, with or without complicating hernia

**Incidence** In private practice hydrocele is frequently seen Of 306,387 admissions to Bellevue during the past 7 years, 187,692 were males, of these 12,274 were admitted to the Urological Service, 440 complained of hydrocele, this number being 3.6 per cent of urological admissions and 0.24 per cent (approximately 1 in 400) of the total male admissions

**Age** Hydrocele in infants is rare, practically always congenital and associated with hernia Of 12 patients in this series under 6 years of age, the youngest being 6 weeks old, 10 had hydroceles definitely present from birth Two cases gave a history of severe scrotal trauma immediately before onset of swelling

Ninety per cent of our patients were over 21 years of age, the condition being most frequently observed (in 27 per cent of the cases) between the ages of 20 and 30 years (Table I) Posner (7) has noted the large number of hydroceles associated with prostatic hypertrophy occurring in old men and has suggested an etiological relationship About 25 per cent of our patients were over 50, the oldest patient was 81 years of age

TABLE I—AGE OF PATIENTS PRESENTING HYDROCELE

Years	Number
Under 6	12
6-14	2
15-19	35
20-29	126
30-39	74
40-49	89
50-59	79
60-69	3
70-79	6
81	1
Not recorded	3
	456

**Side involved** There is a slight predilection for the right side Among our patients, hydrocele was seen on this side 244 times (50.2 per cent) as against 188 times (41 per cent) on the left side Bilateral involvement was noted 44 times

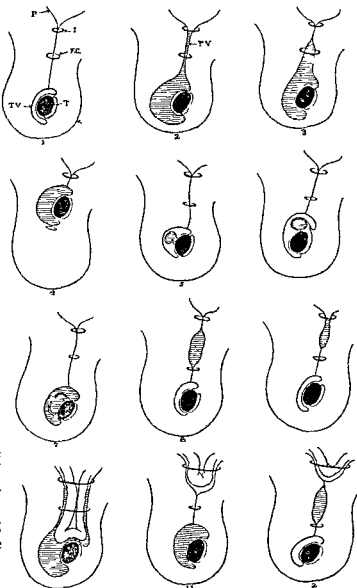


Fig 1 Schematic representation of various types of hydrocele 1 Normal relationship I peritoneum I internal inguinal ring I C fibrous cord (obliterated funicular process) and external inguinal ring T V tunica vaginalis T testis and epididymis, S scrotum 2 Congenital hydrocele P V patent processus funicularis 3 Infantile hydrocele 4 Hydrocele of undescended testicle 5 Hydrocele of testicle 6 Hydrocele of epididymis 7, Bilocular type 8, Hydrocele of cord 9 Hydrocele of hernial sac 10 with hernia (congenital type) 11 Hydrocele of tunica vaginalis with hernia, 12 of cord with hernia

**Duration of disease** As a rule, patients are content to carry a hydrocele for many months until it becomes either painful or, by mere bulk, cumbersome The shortest duration of cases operated upon here was 3 days (twice), the longest 60 years In over 50 per cent, the duration of the lesion was between 2 months and 3 years (Table II)

TABLE II—DURATION OF DISEASE

Time Interval	Day	Number of Weeks	Number of Months	Number of Years	Total
1		4	8		
2		7	5		50
3	2	6	2		28
4	2		9		18
5	3		10		15
6			23		11
7-8			15		12
9-10			19		19
11-12			10		8
13-17			3		16
18-4			15		13
24-40					4
60					1

**Inflammation** Epididymitis is probably the most frequent precursor of hydrocele acute or chronic. It may be of gonorrhœal origin although the tuberculous type is unquestionably too often overlooked. Subacute painless non gonorrhœal epididymitis is of more frequent occurrence than is generally recognized, 161 of our patients admitted one or more attacks of gonorrhœa. Of these at least 32 had acute gonorrhœal epididymitis. Four patients while denying Neisser infection gave a history of acute epididymitis presumably non specific.

Careful examination of the exposed epididymis will in the vast majority of cases reveal a pathological organ showing post inflammatory change—hypertrophy or atrophy. The condition of the epididymis was recorded in but 55 of these cases. The changes noted were chronic inflammation 38 cystic changes 9 acute inflammation 7 (of which 2 showed abscess), tuberculosis 1. In a series personally observed recently well over 90 per cent showed gross evidence of acute or chronic disease of the epididymis. Unquestionably some of these changes are the result of pressure.

Occasionally hydrocele accompanies or follows orchitis. One patient had mumps immediately preceding the appearance of hydrocele. Gumma and tuberculosis, not only of the testis, but of the tunica vaginalis have also been reported (5). Of our patients 34 were proven syphilitic but rarely was it necessary to consider lues in the differential diagnosis. Gumma of the testis was encountered once as a diagnostic error.

**Trauma** An actual blow to the testis preceding onset of swelling was noted by 34 of

these patients. Some fell, some (5 per cent) ascribed the condition to a lifting strain, although the mechanics of this relationship are not clear to us. The incidence of hydrocele in circus riders is said to be high.

A common and also avoidable form of injury is that received at the operating table. Thirty of our patients presented hydroceles which appeared immediately after an operation in the region of the spermatic cord. Post herniotomy hydrocele is well known. Douglas (5) noted hydrocele postoperatively in 35 per cent of a series of varicocele cases. We believe that in operations in which the spermatic cord is manipulated the cord is pulled up sufficiently to expose the upper portion of the vaginalis to trauma in the operative field. For this reason particular care should be observed the cord being held high to avoid proximity to the vaginalis and testis. We believe our care in this respect explains the relative infrequency with which we see post varicocele hydrocele in our follow up clinic. Furthermore, it must be remembered that whenever the testicle or epididymis is attacked surgically an eversion of the vaginalis should always be done before the scrotum is closed.

**Congenital** The congenital form is rare in adults since the condition if present usually disappears spontaneously in later infancy.

Still more rare are those hydroceles secondary to circulatory or lymphatic obstructions such as those caused by truss wearing advanced cardiorenal or hepatic disease or filariasis. It is to be noted that hydrocele is not seen as an accompaniment of generalized ascites. In one instance hydrocele followed an inguinal operation to relieve the œdema of filariasis.

**Idiopathic** The majority of hydroceles fall into the idiopathic group. There is usually a history of swelling with no antecedent local condition. But as "essential" or cryptogenic serositis is rare in other serous cavities so in the tunica vaginalis we feel that inflammation and trauma are the inciting agents much more frequently than is commonly supposed. We believe unrecognized asymptomatic epididymitis is the usual underlying process in cases of hydrocele.

The etiological factors in this series as determined by history are indicated in Table III

TABLE III—ETIOLOGY

		Cas
Trauma	1 Non operative	
	Blow	34
	Fall	8
	Strain	5
	2 Postoperative	
	Hernia	19
	Varicocele	5
	Hydrocele	5
	Filariasis	1
	Infection	
	Gonococcal epididymitis	32
	Mumps	1
	Congenital hydrocele	15
	Idiopathic hydrocele	311

## PATHOLOGY

**Fluid** The fluid of uninfected hydroceles resembles blood serum. It has a specific gravity of 1.020 to 1.026, contains fibrin, albumin (4 to 6 per cent), paraglobulin, at times cholesterol, and phosphatic calculi. Microscopically the fluid shows endothelial cells, cholesterol crystals, white blood cells, often spermatozoa, bacteria in infected cases, and in event of hemorrhage, red cells. The quantity present varies from a few cubic centimeters to several liters, the greatest quantity yet reported being 5 gallons (2).

Caforio (2) has pointed out that in view of the lower specific gravity and smaller serum content of transudates, hydrocele fluid is an exudate of inflammatory origin. Careful study of the epididymis and sac of the involved part seems to bear this out. The same writer shows, furthermore, that were the fluid a transudate of chronic passive congestion, hydrocele would more often complicate varicocele. We noted this association only once.

**Tunica vaginalis** When exposed at operation, the vaginalis is pale unless it is acutely inflamed. If it is inflamed, the membrane shows injection and frequently fibrinous deposits. Adhesions within the sac may be numerous and dense. Especially common are changes in the albuginea. Thick whitish plaques of old fibrinous deposit may give this organ an appearance quite similar to that of the spleen in perisplenitis. In old hydroceles, the sac is greatly thickened and there may be even partial calcification.

**Epididymis** While little emphasized by writers, changes in the epididymis are most noteworthy. Rarely is the organ found to be normal. The changes may be acute or vary from enlargement with chronic induration to marked secondary scarring with contraction or atrophy. The latter condition is probably most often the result of great tension within the vaginalis. This tension may also cause compression of the testis with atrophy, or may bury both it and the epididymis in a thickened wall of the vaginalis. This condition we observed three times.

## SYMPTOMS

If the hydrocele is acute, the result of infection of the epididymis or testicle (rarely the result of trauma), pain is apt to be severe. Pain is usually proportional to tension, great with the rapidly forming hydrocele accompanying acute gonorrheal epididymitis, slight or absent with tuberculous epididymitis.

Chronic hydrocele, uncomplicated by infection, is usually asymptomatic save for swelling. Some complaint of a dragging sensation in the scrotum or along the cord. This is due to mass weight. Pain, if present, is mild as a rule and results from tension. When pain is severe, underlying acute inflammation is found (acute epididymitis orchitis). Table IV designates the symptomatology as elicited from this group of patients.

TABLE IV—SYMPTOMATOLOGY

	Cases
No symptoms	67
Swelling	All others
Pain	
Occasional	13
Slight continuous	44
In cord	7
After lifting	4
Severe (walking impossible)	3
Severe nausea vomiting	2
Tenderness	20
Drag	78

Relative retraction of the penis because of a large hydrocele often prevents coitus, renders catheterization difficult or may be the cause of extensive skin excoriation secondary to urinary difficulties.

## DIAGNOSIS

In hydrocele of the tunica vaginalis, inspection reveals a pear shaped tumor, the mass

TABLE II—DURATION OF DISEASE

Time Interval	Days	No. of Cases	No. of Deaths	No. of Scrotal Infections
1		4	8	
2		7	25	50
3	2	6	22	28
4			9	18
5	3		10	15
6			3	11
7-8			15	12
9-10			19	19
11-12			19	8
13-17			3	16
18-24			15	13
4-60				4
60				1

**Inflammation** Epididymitis is probably the most frequent precursor of hydrocele acute or chronic. It may be of gonorrhoeal origin although the tuberculous type is unquestionably too often overlooked. Subacute painless non gonorrhoeal epididymitis is of more frequent occurrence than is generally recognized. 161 of our patients admitted one or more attacks of gonorrhoea. Of these at least 32 had acute gonorrhoeal epididymitis. Four patients while denying Neisser infection gave a history of acute epididymitis presumably non specific.

Careful examination of the exposed epididymis will in the vast majority of cases reveal a pathological organ showing post inflammatory changes—hypertrophy or atrophy. The condition of the epididymis was recorded in but 55 of these cases. The changes noted were chronic inflammation 38, cystic changes 9, acute inflammation 7 (of which 2 showed abscess), tuberculosis 1. In a series personally observed recently well over 90 per cent showed gross evidence of acute or chronic disease of the epididymis. Unquestionably some of these changes are the result of pressure.

Occasionally hydrocele accompanies or follows orchitis. One patient had mumps immediately preceding the appearance of hydrocele. Gumma and tuberculosis, not only of the testis but of the tunica vaginalis have also been reported (5). Of our patients 34 were proven syphilitic but rarely was it necessary to consider lues in the differential diagnosis. Gumma of the testis was encountered once as a diagnostic error.

**Trauma** An actual blow to the testis preceding onset of swelling was noted by 34 of

these patients. Some fell, some (5 per cent) ascribed the condition to a lifting strain although the mechanics of this relationship are not clear to us. The incidence of hydrocele in circus riders is said to be high.

A common and also avoidable form of injury is that received at the operating table. Thirty of our patients presented hydroceles which appeared immediately after an operation in the region of the spermatic cord. Post herniotomy hydrocele is well known. Douglas (5) noted hydrocele postoperatively in 35 per cent of a series of varicocele cases. We believe that in operations in which the spermatic cord is manipulated the cord is pulled up sufficiently to expose the upper portion of the vaginalis to trauma in the operative field. For this reason particular care should be observed the cord being held high to avoid proximity to the vaginalis and testis. We believe our care in this respect explains the relative infrequency with which we see post varicocele hydrocele in our follow up clinic. Furthermore it must be remembered that whenever the testicle or epididymis is attacked surgically an eversion of the vaginalis should always be done before the scrotum is closed.

**Congenital** The congenital form is rare in adults since the condition if present usually disappears spontaneously in later infancy.

Still more rare are those hydroceles secondary to circulatory or lymphatic obstructions such as those caused by truss wearing advanced cardiorenal or hepatic disease or filariasis. It is to be noted that hydrocele is not seen as an accompaniment of generalized ascites. In one instance hydrocele followed an inguinal operation to relieve the oedema of filariasis.

**Idiopathic** The majority of hydroceles fall into the idiopathic group. There is usually a history of swelling with no antecedent local condition. But as "essential" or cryptogenic serositis is rare in other serous cavities so in the tunica vaginalis we feel that inflammation and trauma are the inciting agents much more frequently than is commonly supposed. We believe unrecognized asymptomatic epididymitis is the usual underlying process in cases of hydrocele.

The etiological factors in this series as determined by history are indicated in Table III

TABLE III—ETIOLOGY

		Cases
Trauma	1 Non-operative	
	Blow	34
	Fall	8
	Strain	25
	2 Postoperative	
	Hernia	19
	Varicocele	5
	Hydrocele	5
	Filariasis	1
Infection	Gonococcal epididymitis	32
	Mumps	1
	Congenital hydrocele	15
	Idiopathic hydrocele	311

## PATHOLOGY

**Fluid** The fluid of uninfected hydroceles resembles blood serum. It has a specific gravity of 1.020 to 1.026, contains fibrin, albumin (4 to 6 per cent), paraglobulin, at times cholesterol, and phosphatic calculi. Microscopically the fluid shows endothelial cells, cholesterol crystals, white blood cells, often spermatozoa, bacteria in infected cases, and in event of hæmorrhage, red cells. The quantity present varies from a few cubic centimeters to several liters, the greatest quantity yet reported being 5 gallons (2).

Caforio (2) has pointed out that in view of the lower specific gravity and smaller serum content of transudates, hydrocele fluid is an exudate of inflammatory origin. Careful study of the epididymis and sac of the involved part seems to bear this out. The same writer shows, furthermore, that were the fluid a transudate of chronic passive congestion, hydrocele would more often complicate varicocele. We noted this association only once.

**Tunica vaginalis** When exposed at operation, the vaginalis is pale unless it is acutely inflamed. If it is inflamed, the membrane shows injection and frequently fibrinous deposits. Adhesions within the sac may be numerous and dense. Especially common are changes in the albuginea. Thick whitish plaques of old fibrinous deposit may give this organ an appearance quite similar to that of the spleen in perisplenitis. In old hydroceles, the sac is greatly thickened and there may be even partial calcification.

**Epididymis** While little emphasized by writers, changes in the epididymis are most noteworthy. Rarely is the organ found to be normal. The changes may be acute or vary from enlargement with chronic induration to marked secondary scarring with contraction or atrophy. The latter condition is probably most often the result of great tension within the vaginalis. This tension may also cause compression of the testis with atrophy, or may bury both it and the epididymis in a thickened wall of the vaginalis. This condition we observed three times.

## SYMPTOMS

If the hydrocele is acute, the result of infection of the epididymis or testicle (rarely the result of trauma), pain is apt to be severe. Pain is usually proportional to tension great with the rapidly forming hydrocele accompanying acute gonorrhoeal epididymitis, slight or absent with tuberculous epididymitis.

Chronic hydrocele, uncomplicated by infection is usually asymptomatic save for swelling. Some complain of a dragging sensation in the scrotum or along the cord. This is due to mass weight. Pain, if present is mild as a rule and results from tension. When pain is severe, underlying acute inflammation is found (acute epididymitis, orchitis). Table IV designates the symptomatology as elicited from this group of patients.

TABLE IV—SYMPTOMATOLOGY

	Cases
No symptom	67
Swelling	All others
Pain	
Occasional	13
Slight continuous	44
In cord	7
After lifting	4
Severe (walking impossible)	3
Severe nausea vomiting	2
Tenderness	20
Drag	78

Relative retraction of the penis because of a large hydrocele often prevents coitus, renders catheterization difficult, or may be the cause of extensive skin excoriation secondary to urinary difficulties.

## DIAGNOSIS

In hydrocele of the tunica vaginalis, inspection reveals a pear shaped tumor, the mass

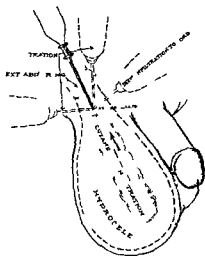


Fig. 1. Method of local anesthetic infiltration.

tapering into the cord. As a rule the outline is felt to be smooth and regular and the mass elastic. Occasionally lobulation is found. The mass is dull to percussion, transmits light, can not be reduced (except the congenital type), and unless complicated by hernia gives no cough impulse.

The cord is normal unless involved in the hydrocele formation.

Over acute hydroceles particularly, the scrotal skin may be tense and shiny, over chronic hydroceles of large size, tense and shiny.

Usually the testis is found behind and below the center of the tumor, rarely is it present anteriorly. Often the organ cannot be localized.

In this series, transillumination was recorded as good in 370 cases, poor in 6, none in 26 and not recorded in 54. Operation revealed turbid fluid or thickened sac in those not transmitting light, yet proving to be hydroceles. Occasionally we encountered difficulty in obtaining transillumination in colored patients with unusually deeply pigmented skin, yet showing sacs which were not abnormally thickened.

Although puncture of the hydrocele and withdrawal of some fluid is the surest diagnostic procedure, it should never be done unless hernia can be ruled out absolutely. We do not use the method.

## DIFFERENTIAL DIAGNOSIS

The more usual conditions from which hydroceles must be differentiated are the following:

**Hernia.** Unless it is incarcerated or strangulated a hernia of such size as to be confused with hydrocele is a tympanic reducible mass with the cough impulse. Reducible congenital hydrocele with associated hernia was noted in 3 of our adult cases. Complicating hernia was present in 61 cases.

**Spermatocele.** Spermatocele is rare and can not usually be demonstrated by transillumination. The testis is most often in front and below. Aspirated fluid shows spermatozoa. One makes the diagnosis most frequently at operation. We diagnosed spermatocele as hydrocele once.

**Hæmatocele.** A history of recent injury with a solid inelastic opaque mass often associated with superficial ecchymosis renders a diagnosis of hæmatocele likely, but traumatic intravaginal hæmorrhage may convert a hydrocele into a hæmatocele.

**Chylocele** is encountered in the tropics. The aspirated fluid is creamy with a layer of fat on top after it is left to stand.

**Gumma** is usually a painless, hard or doughy mass not visible under transillumination. A luetic history or positive Wassermann suggests the diagnosis. We found gumma once.

**The edema of chronic passive congestion** may simulate hydrocele on inspection but the fluid infiltration will be felt in the loose scrotal tissue with the testis and epididymis in normal position.

**Neoplasms of the testes.** Rapid growth with pain, the presence of a solid hard mass, negative findings upon transillumination and later secondary gland involvement usually point to neoplasms of the testes. Involvement of the cord proximal to the tumor is common. We diagnosed a neoplasm as hydrocele once.

Hydrocele associated with imperfectly descended testicle (either inguinal or intra-abdominal) may be confusing. In the presence of an abdominal tumor associated with undescended testes, the possibility of hydrocele must be considered.

## PROGNOSIS

Tapping or the use of a local irritant such as painting the overlying skin with iodine

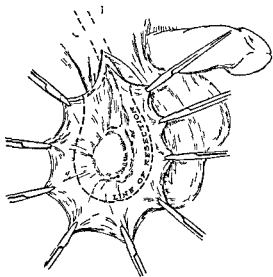


Fig. 3 Exposed vaginalis and testicle. Line of excision.

Fig. 4 Running hæmostatic suture particularly useful in old thickened sacs

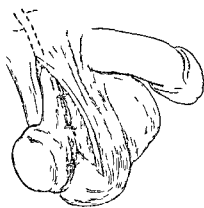
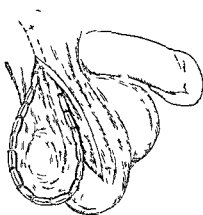


Fig. 5 Method of eversion behind cord

frequently accomplishes a cure in infants. At times, cure is spontaneous. Often complicating hernia demands radical treatment.

In adults, hydrocele shows no tendency to spontaneous cure. Radical treatment is required. Rarely does hydrocele rupture. When this occurs, hæmatoma ensues and the scrotum may simulate elephantiasis, urinary extravasation, or strangulated hernia.

#### TREATMENT

The first surgical treatment of hydrocele dates to antiquity. Celsus incised and drained the sac. Tapping and injection of irritant fluids was practiced early. Internal medication was noted to have no value. Vaccines and autotherapy have at times given temporary results. Today we practice (1) tapping with or without injection, or (2) open operation.

**Tapping.** This is often curative in children. In the 13 cases in infants reported here, it was never used. Eight were cured by open operation and hernioplasty. In 5 the age or mildness of the condition did not warrant operation. Tapping may be used, too, in those adults refusing operation or in those whose physical condition does not warrant an operation. For the latter reason we practiced tapping in 3 cases. Before tapping a hydrocele, hernia must be excluded absolutely. In adults after tapping, the fluid usually reforms.

One in 4 of these patients had been relieved previously by tapping, 53 had been tapped once, 18 twice. One claimed to have been tapped 20 times, 5 had open operations performed elsewhere.

TABLE V — PREVIOUS TREATMENT

Operation	Cases
Tapping	5
Times	
1	53
2	18
3	10
4	5
5	
6	1
7	1
10	2
12	2
20	1
Many	3

**Injection.** Following tapping with complete emptying 5 to 20 minims of pure phenol may be injected and the scrotum thoroughly kneaded to disseminate the drug to all surfaces. The success of this method rests upon the thoroughness of the agglutination of the vaginalis surfaces and the obliteration of the sac. This method is indicated only in uncomplicated hydroceles with thin walls and clear fluid. It should never be used in children because most of these hydroceles communicate with the abdominal cavity and it is impossible to tell whether they communicate or



cases. Of 1,216 cases treated by open operation there were 30 relapses, or 2.4 per cent.

The follow up on our cases operated upon 1 to 17 years ago has been rather unsatisfactory because of the extreme difficulty in locating members of a more or less floating population in a great city. We have however personally examined 33 of these 456 patients. There was evidence of fluid estimated as 2 to 4 cubic centimeters in 4 of these, always at the upper pole and quite apart from the testicle. In 2 cases there was definite recurrence. Reoperation was performed once. It was found that two layers of remaining tunica were glued together with cyst formation not involving the testicle but rather just above it.

#### SUMMARY

Hydrocele is a relatively common condition and constitutes about 3.6 per cent of all urological cases requiring hospital care.

In about 25 per cent the etiology is undetermined. Infection and trauma are chief of the known causes. Probably painless subacute epididymitis (non venereal) is the underlying factor in a great number of instances.

The condition is observed most frequently in young adults. In infancy it is usually congenital and associated with hernia.

Acute hydrocele is usually symptomatic, pain is the chief complaint. In the chronic type, a sense of mass and weight is noted.

Transillumination of a scrotal mass is pathognomonic of hydrocele. Differential diagnosis is extremely difficult at times.

While simple tapping with or without injection of irritants relieves many open operations, preferably excision and eversion of the sac is the procedure of choice.

Local anesthesia is most satisfactory in these cases.

The hemostatic scrotal compression bandage herein described is of great service following operation.

Complication is not uncommon, loss of the testicle by infection being probably the most severe. Undue handling of the scrotal skin at operation is to be avoided that danger of contamination may be minimized.

Two of our patients died following surgical treatment, both of bronchopneumonia. One of these deaths followed simple tapping without injection.

The average stay in the hospital of all cases was 9.4 days; of uninfected cases 6.1 days.

The chance of recurrence is about 3 times greater following tapping and injection than after the open operation.

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# CLINICAL SURGERY

*FROM THE SURGICAL CLINIC, LANKENAU HOSPITAL*

## GASTRO-ENTEROSTOMY

By JOHN B. DEEVER, M.D., D.Sc., LL.D., F.A.C.S., PHILADELPHIA

FEW innovations in gastric surgery enjoyed the immediate adoption accorded the operation of gastrojejunostomy. This distinction is all the more noteworthy inasmuch as the operation as originally performed was not the practical application of a theory or a previously planned step, but an emergency measure in an apparently inoperable case of gastric malignancy.

Other distinctions enjoyed by the procedure are the tremendous amount of literature which it has brought forth and its persistence as a fruitful source of controversy down to the present hour. It will, no doubt, continue to be a subject of discussion as long as the diseases to which it is applied continue to annoy the human body, or until some entirely different surgical procedure is devised for the treatment of the disorders to which it is applied, or until perhaps, at some remote future time the dream of the medical cure of such diseases will have been realized, or better still, the digestive disturbances of civilized man will have been entirely overcome. Until one or another of these eventualities takes place the gastrojejunal anastomosis will necessarily occupy a prominent place in surgical history.

As it is used today, gastrojejunostomy is generally performed for the relief of pyloric obstruction due to ulcer, carcinoma, or the results of these and other obstructive diseases. One of its main purposes in the treatment of ulcer, its complications and sequelæ, is to side-track the irritating action of food and of the gastric acid juices on the affected portion of the stomach or the duodenum. In inoperable carcinoma it is designed to act as drainage for the stomach, while in the operable case, with resection, the anastomosis is essential for establishing the continuity of the gastrointestinal tract.

It is in the treatment of duodenal ulcer that the operation finds its greatest use. While it is true that it does not yet provide one hundred

per cent of cures, it is without doubt the most beneficent surgical method of treating this condition.

The operation itself is not a dangerous one, and with the properly selected moment and the proper preparation of the patient, its mortality should not be high. Nor are the immediate complications much to be feared if the immediate postoperative treatment is carefully planned and carried out. The percentage of cures in the cases traced by the Lankenau follow-up clinic is about 85 per cent. This does not include the cases which cannot be traced, and which on the basis of analogy it is reasonable to assume would add 2 or 3 per cent to the cured cases. These figures refer mainly to gastric and duodenal ulcers. The most serious remote effect of the operation to be feared is, of course, marginal, gastrojejunal, or jejunal ulcer, which may be expected in from 1 to 3 per cent of the cases.

The theories offered to explain the development of this unpleasant sequel are numerous and various. Retained suture or sutures as a possible cause are seen in the following two cases.

The patient, a laborer, male, 26 years of age, was admitted to the Lankenau Hospital on May 11, 1906, with all the signs and symptoms of acute perforating duodenal ulcer. Operation was resorted to at once 4 hours after the onset of the symptoms. Through an upper right rectus incision a very much diseased appendix was removed and after the surrounding adhesions had been separated an ulcer was found in the first portion of the duodenum with an indurated area about 3 centimeters in diameter, in the center of which was a perforation about  $\frac{1}{2}$  centimeter in diameter. The ulcer was oversewn with linen and inverted and a gastrojejunostomy performed followed by a jejunojejunostomy at a point about 5 centimeters below the first anastomosis. The patient made an uneventful recovery and was discharged on the thirteenth day. He returned to the follow-up clinic on September 24, 4 months after operation, feeling well, except for occasional gas on the stomach and an occasional dull dragging epigastric pain. He was paying no attention to his diet. Fluoroscopic examination at that time showed a rather spastic stomach, considerable deformity at the stoma, and a suggestion of marginal ulcer although no crater was seen. The old deformity of the duodenum was present. The barium meal

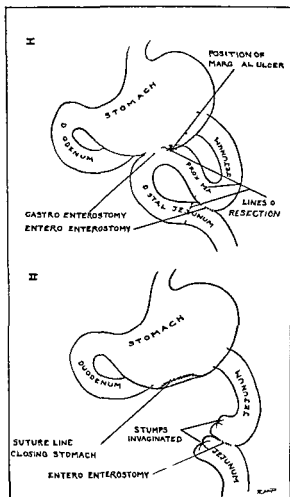


Fig. 1. Diagram of operation done for marginal ulcer

passed through both openings. A test meal showed maximum free hydrochloric acid of 36 in the first specimen and maximum total of 76 in the last specimen. The stomach contents showed much starch, fat and mucus and gave a positive reaction to guaiac for blood. The patient was given advice as to diet and was asked to return to the follow up clinic in 6 months.

Because of the persistence of the epigastric distress he came before that time and was re-admitted on December 3, 1926. Although he had been following instructions as to diet about 3 weeks before admission he began having more or less constant dragging epigastric pain aggravated at night. The pain for the past 10 days was severe enough to compel him to quit work with resultant relief of pain for the past 2 days. The fractional test meal at this time showed considerably lower readings than at the former examination the maximum free hydrochloric acid being 30 in the second (with none in the seventh and eighth) specimen and the total 50 in the third specimen. The 8-hour test meal showed no retention free hydrochloric acid 18 total hydrochloric acid 72. At the second operation on December 9 the old scar was excised and an induration found at the site of the posterior gastrojejunostomy. The

anastomosis was unhooked and the original conditions restored. A piece of linen suture was found in the stomach wall at the site of the anastomosis. The portion of the jejunum above the old gastrojejunostomy was resected and an ulcer the size of a nickel was found at the site of the anastomosis. The ulcer was excised and the cut ends of the bowel united. The incision was closed without drainage. The pathological report read acute and chronic ulcer. The patient was discharged in good condition on December 21, 1926. Figure 2 shows the condition found at the second operation.

E. M. male age 38 years was operated upon August 1926. A duodenal ulcer was found and excised and posterior gastro enterostomy done. The patient recovered and remained well until 2 days before Christmas, 1926 when he was attacked with epigastric pain 2 to 3 hours after eating. This pain was relieved by eating. This condition continued until February, 1927 when he re-entered the Lankenau Clinic. The diagnosis was probable marginal ulcer yet the X-ray findings were negative.

**Operation.** Adhesions of the great omentum to the parietal peritoneum and under surface of the liver were released. Careful examination of the gastrojejunostomy was negative. The stomach was opened through the anterior wall and the posterior gastro enterostomy brought up through the incision and examined. Embedded in the mucosa at the site of the anastomosis were two silk sutures which were removed. The mucosa from which the silk was taken was reddened and puckered and showed some evidence of inflammation but no ulceration. In a short time however this no doubt would have developed into an ulcer. Relief of symptoms followed recovery from operation.

Marginal ulcer carries with it the same inherent possibilities of primary peptic ulcer such as hæmorrhage and acute perforation. These sequelæ therefore are to be feared and in a measure detract from the other wise satisfactory results of gastrojejunostomy. Nevertheless it still remains the operation of choice for most cases of duodenal ulcer especially since gastric resection so widely advocated by European surgeons notably Finsterlin and his followers does not entirely obviate the same unpleasant remote result. This fact alone makes partial gastrectomy too formidable a measure if the same purpose can be served by less extensive surgery.

Although as a rule the diagnosis of the condition for which a gastro enterostomy is indicated can be approached on the basis of the clinical history nearly all cases should have the benefit of a pre-operative study for the more exact determination of the extent of the pathological physiology. Gastric analysis to estimate the degree of retention (if any) the degree of acidity and so forth and an analysis of the vomitus and fæces should be routine measures. X-ray demonstration of the ulcer or other pathological conditions is desirable but as is well known it is not always decisive inasmuch as certain lesions do not show up in this

form of study. It goes without saying that the usual kidney functional tests, blood analysis, urinalysis, and blood count, as applied to all surgical prospects, are in order.

At the Lankenau Hospital the preparation of the patient in the chronic cases consists in making the tests already mentioned. The fractional test meal also is the usual routine although the 8 hour meal with prunes and raisins is given in certain instances. In the very chronic case of long standing, gastric lavage is sometimes ordered. The weakened and bleeding patient is put on "regulation" diet, and glucose and whiskey and pure beef juice are administered in the same manner as constant saline injections. The only tests made in such cases are the blood tests. The morning of the operation the bowels are cleaned out by an enema.

When we speak of gastrojejunostomy, unless other methods are mentioned, we usually have in mind the posterior no loop anastomosis which is really Hacker's modification of Woelfler's original anterior long loop method.

#### TECHNIQUE

The technique of the operation is not difficult, but making the new stoma just the proper size requires certain judgment and care, gained by observation and experience. Too small an opening is as unwise as too large a one. The incision, about 10 centimeters in length, is made through the right rectus muscle close to the median line extending from below the ensiform cartilage almost to the umbilicus. A careful examination of the entire operative field is imperative. In ulcer cases, for example, it is not at all unusual to find a lesion in both the stomach and the duodenum. The entire stomach should be in view and palpated before any operation upon it is attempted. The operator then makes sure that the posterior wall of the stomach is accessible through the transverse mesocolon. Before taking this step, however, he should cover all skin surfaces surrounding the abdominal incision with hot moist gauze pads, in order to protect the viscera that may have to be drawn out of the abdomen. The greater omentum with its attached transverse colon is drawn into the wound and turned upward to the hot gauze pads. This brings into view the primary coil of the jejunum. Occasionally the first few centimeters of the jejunum are attached to the under surface of the greater omentum by adhesions, or the mesocolic ligament, arising from the under surface of the mesocolon and attached below to

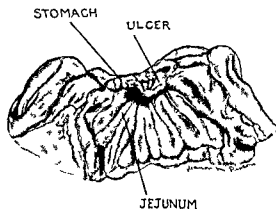


Fig. 2. Drawing of specimen showing condition found at second operation.

the jejunum, is found extending 7 to 10 centimeters into the gut. This should be divided until the jejunum is free up to its origin. In order that the physiological action of the new opening may resemble as nearly as possible that of the natural pyloric orifice the site of the anastomosis should be in the dependent pyloric portion of the stomach. It is our practice to make the opening in the transverse mesocolon nearer the vertebra than the transverse colon, to prevent a possible gastrojejunocolic fistula should a marginal ulcer develop.

As already indicated, much of the success of gastrojejunostomy depends on the immediate postoperative treatment. In the Lankenau Hospital while this may be regulated according to the individual case, as a general rule the first measure after operation is hypodermoclysis of 1,000 or 1,500 cubic centimeters of normal salt solution followed in 24 hours by the constant Murphy drip with whiskey. Nothing is given by mouth for 24 to 48 hours except hot water or ice chips. Nourishment may be given on the second or third day consisting of albumen, milk and lime water (half and half), or clear broths. No solid food is given during the first week, after that a soft diet is allowed. The patient usually leaves the hospital after the second or third week, and on discharge is given a diet list together with injunctions to avoid all fried and fatty foods, sweets and pastry for at least 1 year after operation. The follow up clinic keeps these patients under observation for 2 or 3 years (cancer cases 5 years) and in many instances a test meal and fluoroscopic study are made from time to time as a basis of comparison between the preoperative and postoperative behavior of the stomach and gastro intestinal tract.

IAOM SURGICAL CLINIC NO 1, DIRECTOR PROF T V VEREBLLI

## TECHNIQUE OF GASTRIC RESECTION

By DR ERNEST NEUBER BUDAPEST HUNGARY  
D t

A GREAT many operations have been designed to cure or eradicate gastric and duodenal ulcer but their large number is sufficient proof of the inadequacy of any one of them

It is a great pity that we are not as yet fully acquainted with the etiology of gastric and duodenal ulcer. The ulcer cannot be considered a simple localized disease because often the patient shows a constitutional tendency toward ulcer that plays no inconsiderable part in its existence or continuance and possibly in its recurrence

Therefore we may remove the ulcer but cannot in many cases prevent the so called inherent constitutional ulcer tendency from forming another ulcer

The result is that there are two groups of surgeons with entirely different ideas as to which is the most effective procedure to be followed. One group prefers a simple posterior gastro-enterostomy the other resection of the ulcer together with a great part of the pyloric end of the stomach and the pylorus. Both groups have their prominent and well known advocates among surgeons but the unsettled state of the question makes it rather difficult to form an opinion

Besides theoretical reflections the question of surgical technicalities plays likewise a great part. The simple gastro-enterostomy is undeniably a simpler procedure than the gastric resection though the magnitude of the latter may be considerably reduced by a well developed technique

In our opinion the reason the group giving preference to the simple gastro-enterostomy is such a large one is that this procedure requires far less skill than a gastric resection

By this we do not by any means wish to say that according to our opinion technical knowledge itself forms the main factor in deciding upon the type of operation to be employed because theoretical reflections play exactly the same part when we are deciding upon the merits of the two procedures

Improvement in the technique of local anæsthesia has resulted in a large increase in the number of those doing gastric resections. We ourselves are numbered among these

Formerly it was always a matter of grave concern to employ ether as a means of narcosis for 1 or 1½ hours with a patient in poor physical condition while now with a patient in exactly the same condition of health we safely employ with the best of results splanchnic anæsthesia

One drawback to splanchnic anæsthesia is that one has always to take into consideration besides the apprehensiveness and sensitiveness of the patient also the nervousness of the surgeon which in an occasional case renders it necessary to resort to general anæsthesia. Furthermore, it must be remembered that the surgeon's skill and self control are put to a greater test when splanchnic anæsthesia is employed because it requires a more highly developed technical knowledge more care and more gentleness throughout the operation

The results of operations done in our clinic under splanchnic anæsthesia are undoubtedly better. Disregarding the higher percentage of good results in those surviving operation and those who are permanently cured it is an undoubted fact that the postoperative condition is decidedly better than when the operation is done under general anæsthesia. Postoperative vomiting imposes a severe strain upon the suture line of the anastomosis and the abdominal wall suture and detracts from the strength of the patient. After splanchnic anæsthesia postoperative vomiting is extremely rare and of a very mild transient character. In our clinic the use of Huell's sewing clamp is a great advantage in stomach resection because it not only shortens and simplifies the operation, but at the same time secures perfect hæmostasis

We have never experienced any disadvantages with this system of suturing. Furthermore the staples placed in position along the suture line by this clamp are sloughed out after a short time into the gastric cavity together with any devitalized and sloughing particles of stomach wall along the line of resection passing out therefrom through the opening of the anastomosis

The use of this clamp shortens the time of operation approximately 20 minutes which cannot be despised especially in the case of patients in indifferent or poor condition

## TECHNIQUE

The patient is given the usual pre operative care and treatment. One hour before the operation he receives hypodermically 1 or 2 centigrams of morphine. Anæsthesia of the abdominal wall is secured by infiltration with  $\frac{1}{2}$  per cent novocain tonogen solution in the form of a rhombus, so that the upper corner of the rhombus is at the tip of the xiphoid process, and the lower corner a finger's breadth below the umbilicus.

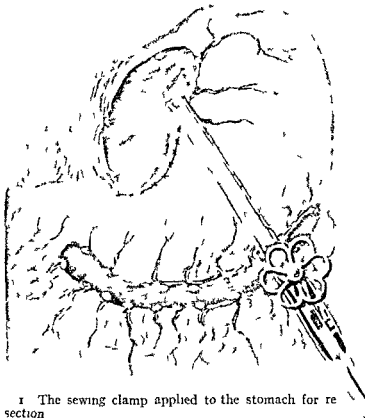
It is important to carry out the anæsthesia of the abdominal wall with accuracy, so that the patient will not only not feel the incision, but also during the operation will not be annoyed by the retraction of the abdominal wall, which is of rather long duration. Another drawback of an inaccurately accomplished anæsthesia is that the patient does not relax the abdominal wall, and consequently one has to contend during the operation with a tense or rigid musculature, and with a tendency of the intestines to extrude themselves from the abdominal cavity unless we resort immediately to ether anæsthesia.

The incision of the abdomen extends in the midline from the xiphoid process to about two fingers' breadth below the umbilicus. The abdominal layers are incised separately in the usual manner, hæmostasis carefully secured, and the peritoneum grasped between tissue forceps and opened.

After the abdomen has been opened we inspect and examine the viscera, and ascertain the location and extent of the ulcer, as well as its relation to adjacent structures. If we find the case to be a suitable one for resection, and if there are not too many adhesions along the lesser curvature, we begin by doing the injection for splanchnic anæsthesia according to the method of Braun. This method is the one we always employ, as after considerable experience we have found it to be absolutely without danger if properly and accurately done.

The injection should be made easily and should never be forced. If one is unable properly to inspect and palpate the point of injection, the local anæsthesia should immediately be discontinued and general anæsthesia resorted to.

When the needle with which the injection is made, is in the proper location, the syringe should invariably be aspirated. It is of no importance if a little blood mixed with air is drawn into the syringe, and the 100 cubic centimeters of  $\frac{1}{2}$  per cent novocain solution may be slowly injected. On the other hand, if the syringe when aspirated promptly fills with blood, the needle is at once withdrawn because in all probability the



1 The sewing clamp applied to the stomach for resection

inferior vena cava has been perforated by the needle.

Upon the completion of the splanchnic injection the abdominal wall vessels are ligated. The advantage gained by this procedure is a two fold one, in that we work upon the delicate abdominal wall with hands uncontaminated by gastric or duodenal contents, and we may profitably employ the time until the anæsthesia is complete, although there is no doubt that in the majority of cases the anæsthesia begins upon completion of the injection, but this should not be accepted as a rule. In a great many of my cases I have found that anæsthesia is complete in 10 minutes after finishing the injection. In cases like this it is most advantageous to use these few minutes for ligation of blood vessels rather than any attempt at manipulation of the viscera.

Next the field of operation as well as the abdominal wall, are isolated. Skin towels are fastened to both sides of the incision by means of skin clips in the usual way, additional towels are placed on top of these and by means of peritoneal hæmostatic forceps, the peritoneum is attached to these in a similar manner.

On completion of this the stomach and omentum major are raised out of the abdomen, and the remaining viscera packed off with long gauze packs. Although this latter procedure is a convenient one for the surgeon, it is disadvantageous

FROM SURGICAL CLINIC NO 1 DIRECTOR PROF T V IEREBELY

# TECHNIQUE OF GASTRIC RESECTION

By DR ERNEST NEUBER BUDAPEST HUNGARY  
D e t

A GREAT many operations have been designed to cure or eradicate gastric and duodenal ulcer but their large number is sufficient proof of the inadequacy of any one of them

It is a great pity that we are not as yet fully acquainted with the etiology of gastric and duodenal ulcer The ulcer cannot be considered a simple localized disease because often the patient shows a constitutional tendency toward ulcer that plays no inconsiderable part in its existence or continuance and possibly in its recurrence

Therefore we may remove the ulcer but cannot in many cases prevent the so called inherent constitutional ulcer tendency from forming another ulcer

The result is that there are two groups of surgeons with entirely different ideas as to which is the most effective procedure to be followed One group prefers a simple posterior gastro-enterostomy the other resection of the ulcer together with a great part of the pyloric end of the stomach and the pylorus Both groups have their prominent and well known advocates among surgeons but the unsettled state of the question makes it rather difficult to form an opinion

Besides theoretical reflections the question of surgical technicalities plays likewise a great part The simple gastro-enterostomy is undeniably a simpler procedure than the gastric resection, though the magnitude of the latter may be considerably reduced by a well developed technique

In our opinion the reason the group giving preference to the simple gastro-enterostomy is such a large one is that this procedure requires far less skill than a gastric resection

By this we do not by any means wish to say that according to our opinion technical knowledge itself forms the main factor in deciding upon the type of operation to be employed because theoretical reflections play exactly the same part when we are deciding upon the merits of the two procedures

Improvement in the technique of local anesthesia has resulted in a large increase in the number of those doing gastric resections We ourselves are numbered among these

Formerly it was always a matter of grave concern to employ either as a means of narcosis for 1 or 1½ hours with a patient in poor physical condition while now with a patient in exactly the same condition of health we safely employ with the best of results splanchnic anesthesia

One drawback to splanchnic anesthesia is that one has always to take into consideration besides the apprehensiveness and sensitiveness of the patient also the nervousness of the surgeon which in an occasional case renders it necessary to resort to general anesthesia Furthermore it must be remembered that the surgeon's skill and self control are put to a greater test when splanchnic anesthesia is employed because it requires a more highly developed technical knowledge more care and more gentleness throughout the operation

The results of operations done in our clinic under splanchnic anesthesia are undoubtedly better Disregarding the higher percentage of good results in those surviving operation and those who are permanently cured it is an undoubted fact that the postoperative condition is decidedly better than when the operation is done under general anesthesia Postoperative vomiting imposes a severe strain upon the suture line of the anastomosis and the abdominal wall suture and detracts from the strength of the patient After splanchnic anesthesia postoperative vomiting is extremely rare and of a very mild transient character In our clinic the use of Huelst's sewing clamp is a great advantage in stomach resection because it not only shortens and simplifies the operation but at the same time secures perfect hæmostasis

We have never experienced any disadvantages with this system of suturing Furthermore the staples placed in position along the suture line by this clamp are sloughed out after a short time into the gastric cavity together with any devitalized and sloughing particles of stomach wall along the line of resection passing out therefrom through the opening of the anastomosis

The use of this clamp shortens the time of operation approximately 10 minutes, which cannot be despised especially in the case of patients in indifferent or poor condition

## TECHNIQUE

The patient is given the usual pre operative care and treatment. One hour before the operation he receives hypodermically 1 or 2 centigrams of morphine. Anæsthesia of the abdominal wall is secured by infiltration with  $\frac{1}{2}$  per cent novocain solution in the form of a rhombus, so that the upper corner of the rhombus is at the tip of the xiphoid process, and the lower corner a finger's breadth below the umbilicus.

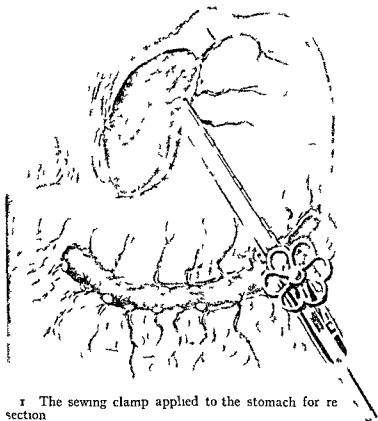
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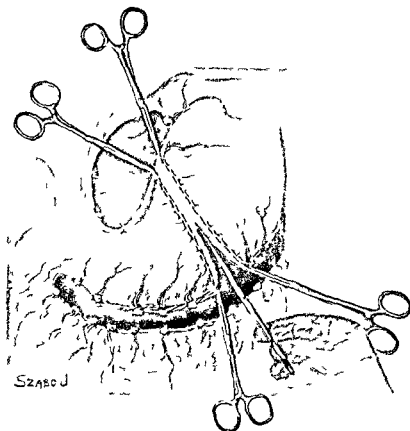
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On completion of this, the stomach and omentum major are raised out of the abdomen, and the remaining viscera packed off with long gauze packs. Although this latter procedure is a convenient one for the surgeon, it is disadvantageous



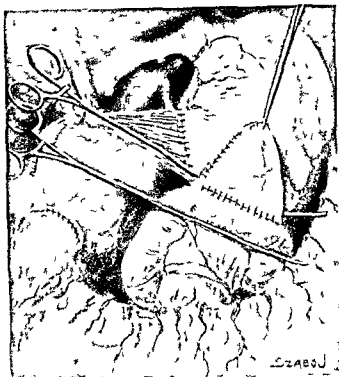


2 Cutting between the two rows of staples after the sewing clamp has been removed

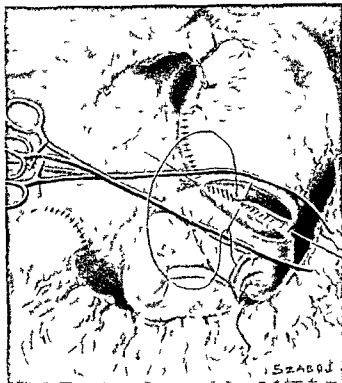
to the patient. When gauze packs are placed in the abdominal cavity the intestinal serosa as well as the peritoneum may be easily injured. This tends to create adhesions. For this reason I have abandoned the use of packs in the abdominal cavity, but consider it quite sufficient to cover the small intestine with a large gauze pad.

The second part of the operation is begun by clamping each vessel of the omentum major and minor supplying that portion of the stomach to be resected between hæmostatic forceps and by cutting them between the clamps. In view of the fact that the large number of forceps employed may hinder the work of one with limited experience it is far more simple to tie off this circulation one vessel at a time by the use of an aneurism needle carrying two ligatures ligating each vessel twice and cutting between the ligatures. The ligation is generally begun along the greater curvature at the point where the resection is to be made and continued in the direction of the duodenum. In like manner it is carried out along the lesser curvature.

After freeing the pylorus and that part of the stomach to be resected the sewing clamp is placed on the stomach in such a way that the long axis of the clamp corresponds to the longitudinal axis of the patient's body. The stomach is properly adjusted in the jaws of the clamp which are then closed and the wheel or rotating handle of the clamp then turned until the ends of the staples are clinched. The stomach has now been crushed along the line of resection, and the anterior and posterior walls closely stapled together with two rows of staples along the same line securing a very perfect hæmostasis. The clamp is now removed and the stomach cut through between the two rows of staples. The proximal or remaining part of the stomach is wrapped in a hot wet gauze pad and turned aside to the patient's left out of the immediate operative field for the time being. The pyloric stump or end of the stomach is similarly covered and the pylorus and first few centimeters of the duodenum are then mobilized. This is generally an easy task provided the ulcer is situated on the



3 Beginning the anastomosis between the jejunum and the lower corner of the stomach



4 Suturing all the layers after resection of the lower corner and opening jejunum

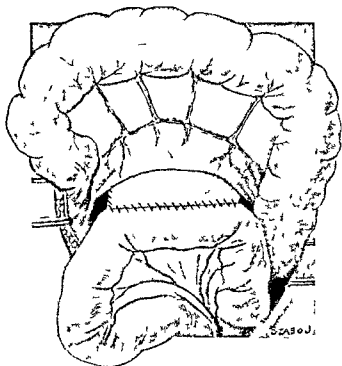
pylorus, but it is more difficult in cases of duodenal ulcer, because in the latter case great care is required in separating the frequently existing dense adhesions between the duodenum and the head of the pancreas

If the duodenal stump has been freed or mobilized sufficiently, its closing may also be carried out by the use of the sewing clamp. If such be the case, the duodenum is cut between the two rows of staples, and the stump closed with continuous catgut suture, passing through all layers, and this suture in turn inverted and covered with interrupted braided silk serosal sutures. The reinforcement and inversion of the duodenal stump requires utmost care, for insufficiency of the suture line may cost the life of the patient. The ulcer as well as part of the stomach having been resected, the second part of the operation is completed

After the blind closing of the duodenum, the gastric stump is removed from its wet gauze wrappings and drawn anteriorly toward the midline, and two thirds of the row of staples along the line of resection placed in with the sewing clamp, in inverted with braided silk serosal sutures, the remaining one third lying toward the greater curvature being left free

Should the stomach be smaller than usual, it is necessary to invert only half of the staples in accordance with the technique described

That part of the stomach which was left free is now grasped with an intestinal clamp in such a manner as to form a triangular shaped corner. The jejunum is brought through an opening in the transverse mesocolon, grasped with an intes



5 The completed anastomosis showing the opening in the transverse mesocolon to be attached to the stomach

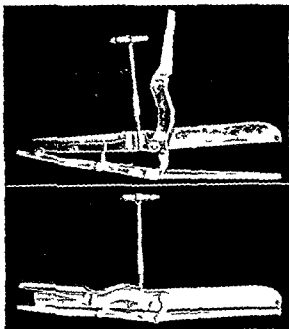


Fig. 1. Side view of the opened and closed Huelst Fischer sewing clamp

tinal clamp in a similar way and approximated to the stomach corner so as to be isoperistaltic.

After isolating this portion of the stomach and jejunum from the adjacent structures they are firmly sutured with braided silk sutures, in a continuous strand. The stomach corner is then simply amputated and the jejunum opened. All the layers are then approximated by continuous through and through catgut sutures in such a way that the sutures on the right side pass from inside out and those on the left from outside in until the starting point is reached. The intestinal clamps are now removed from the stomach and jejunum and the anterior suture line buried by interrupted silk sutures. The utmost care must be exercised at the points where the anterior and posterior suture lines join. At this point it is not so much the insufficiency of the suture line that has to be feared but rather that as a consequence of too careful suturing the efferent loop may become constricted. Needles to say this error may be avoided by a little practice.

After the anastomosis has been completed we attach it to the mesocolon by suturing the margins of the opening in the latter to the stomach a finger's breadth above the suture line of the anastomosis. The stomach and jejunum are now replaced and the abdominal wall closed as follows. Closure is practically always without drainage. Rarely, when we have not succeeded

in suturing the duodenal stump accurately and in a manner to set one at ease, we have placed a cigarette drain in the region of the stump.

The peritoneum is sutured with continuous and the muscles with interrupted silk sutures and the fascia with alternate interrupted silk and catgut sutures.

The above described method is a result of many years' experience, and has been followed in our clinic for the last 4 years. Nothing can better prove the advantages of this procedure than the circumstance that ever since we have followed the technique of the corner anastomosis we have abandoned all the various kinds of resections formerly employed by us. In every case whenever a resection may be employed the above described method is the procedure we follow.

By this we do not mean to say that other procedures are of no use whatsoever but we assert that among all the methods of anastomosis as far as simplicity and results are concerned the corner anastomosis stands first. At the Congress of Hungarian Surgeons held at Budapest in 1935 Professor Verebely while giving an account of gastric operations performed in our clinic, at the same time mentioned the above as the method followed by us.

The duration of the entire operation lasts in simple cases 45 minutes in more difficult ones 1 hour and 25 minutes but in the hands of an efficient surgeon should never exceed 1½ hours.

We purposely have not gone into the question of preparation and after care of the patient because the preparation but more especially the after care cannot be carried out in a mechanical fashion. It is but natural that we use the utmost care both in the preparation and after-care of a patient especially in cases where on account of partial or complete pyloric obstruction the patient is greatly dehydrated. The employment of infusions of physiological salt solution and eventually blood transfusion both before and after operation is very appropriate.

The results of a well done corner anastomosis are excellent. Among the 226 cases done after the method described we have remarked no vicious circle. The holding capacity of the gastric stump is in the majority of cases an excellent one. We have so far neither seen the constriction of the anastomosis opening nor have we noted the occurrence of ulcus jejuni.

We may safely recommend our procedure on account of its simplicity, the rapidity with which it can be performed and its comparative safety. In the last 100 cases our postoperative mortality from all causes was 3.3 per cent.

TUMORS OF THE CAROTID BODY<sup>1</sup>

By RAYMOND P. SULLIVAN, M.D., F.A.C.S., NEW YORK

Surgeon, St. Vincent's Hospital

AND

ALEXANDER FRASER, M.D., NEW YORK

Consulting Pathologist, St. Vincent's Hospital

THIS report of 2 cases of tumor of the carotid body is justified, first because of the rarity of such neoplasms, and second because the respective tumors represent the two most common differentiating neoplastic forms of the neuro epithelium from which the carotid body is derived. Only about 100 cases of tumors undoubtedly taking origin from the tissues of this organ have been reported in the literature, Birman (3) having collected 95 cases in 1924 and Goepel (11) having reported the last one in 1926. The most common histological structure found in these neoplasms all authors are agreed, imitates more or less closely that of the normal carotid body, that is, a sinusoidal arrangement of the alveoli of fully differentiated paraganglion or chromaffin cells. The structure of a second group representing the remainder of the reported cases has been variously described and interpreted as "sarcoma," "sarcomalike," "psuedo sarcoma," "endothelioma" etc., names which at once suggest uncertainty as to diagnosis. A thorough study of the histology of the second case here reported and of the reported cases indicate that at least some of these various histological pictures represent different stages of cell maturation in another line of differentiation of the neural crest epithelium from which the sympathetic nervous system is derived, for example, neuroblasts giving rise to neuroblastoma or capsule cells or perhaps Schwann sheath cells giving rise to neuroblastoma like tumors without true ganglion cells or axis cylinders.

## REPORT OF CASES

CASE 1 (St. Vincent's Hospital—989-25) The patient a woman of 49 years 10 years ago following an attack of tonsillitis first noticed a swelling on the right side of the neck just below the angle of the jaw. From the original size of an almond this swelling gradually increased to that of a small peach. At times, the volume of the swelling was considerably lessened. According to the patient's statements the weather seemed to have an influence on its behavior but it never entirely disappeared. The swelling was associated with slight but constant ache. On inspection a mass of irregular configuration was found situated in the upper part of the right neck, extending from the angle of the jaw downward to the middle of the neck, and upward behind the lobe of the right ear. The tumor was semisolid in consistency, not tender on pressure,

slightly movable transversely but not vertically and measured to by 7 by 5 centimeters. The overlying skin was not attached to the tumor.

On the basis of the findings of local examination and the negative results of general examination a tentative diagnosis of right cervical adenitis or carotid body tumor was made and operation advised. At operation the mass was revealed as a tumor of brownish red color with a smooth slightly undulating vascular surface. On palpation it pulsed and appeared to be intimately connected with the large vessels. These observations, together with its apparent position in relation to the carotid bifurcation, led to the diagnosis of tumor of the carotid body.

Operation, July 9, 1925. The incision including the skin and platysma, was made along the inner border of the right sternocleidomastoid muscle from the tip of the mastoid to the level of the lower pole of the thyroid. The internal jugular vein was found distended, displaced and very adherent to the tumor and surrounding tissues. With difficulty the tumor was mobilized after intricate dissection and ligation of the numerous vessels entering the capsule. The excessive bleeding encountered was sufficient at one stage to suggest the possibility of an aneurism, but this was not confirmed.

The internal jugular vein while being released and drawn medially was injured on its external side close to the jugular foramen causing considerable hemorrhage which was controlled with difficulty. All bleeding was finally arrested by ligatures and the tumor removed. The carotid crotch was thus demonstrated (Figs. 1 and 2). The platysma and skin were sutured separately and a small rubber dam drain was placed in the lower angle.

The postoperative diagnosis was tumor of the carotid body.

The postoperative course was satisfactory until the second day when the patient had a severe hemorrhage from the wound. On examination the suture line of the platysma was found ruptured and the source of hemorrhage was seen to be a tributary of the internal jugular vein which was freed from its ligature and bleeding freely. The stump was again ligated and the wound resutured after which a transfusion of 550 cubic centimeters of whole blood and 40 cubic centimeters of saline was given. On the following day the patient had a mild aphonia but laryngoscopic examination revealed no abnormality in the vocal cords. There was contraction of the right pupil. The patient also complained of some difficulty in swallowing. All these conditions gradually cleared up and in 3 months the patient reported perfect health, which has persisted up to the time of the last examination made in November 1926 about 17 months after the operation.

Pathology. The tumor after removal was considerably smaller than the mass felt before operation. It was ovoid in shape and measured 4 by 3 by 2 centimeters. It had a tough fibrous capsule penetrating which were numerous thick walled gaping blood vessels. It was at first deep red in color but as it lost blood it assumed a brownish red color. The cut surface strongly reminded one of the

<sup>1</sup>Read before the Southern Surgical Association, Biloxi, Mississippi, December 14, 1926.

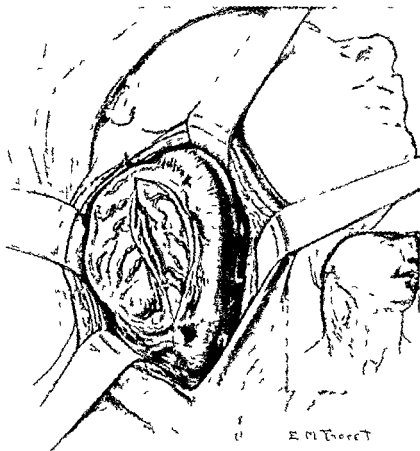


Fig. 1. Case 1. Paraganglioma of the carotid body.

thyroid in parenchymatous goiter. It was divided into numerous lobules by connective tissue bands of varying thickness in which were numerous wide open thick walled blood caverns (Fig. 3).

**Histology.** The histological structure was with few variations that of the normal carotid body (Figs. 4 and 5) that is a uniformly arranged unsoidal architecture even showing nests of large epithelioid like cells. In the peripheral portions the cells appeared to grow directly outward from the endothelium lining the capillaries separating and surrounding the cell nests. In the central portion the connective tissue stroma and the walls of the vessels were greatly thickened so that a wide band of hyalinized fibrous tissue separated the cell nests from the vessel endothelium (Figs. 6 and 7). The cells were large and in most places formed a syncytium like the chromaffin cells of the adrenal medulla. The shape of the individual cells when visible was polyhedral; the cytoplasm abundant and granular and the nucleus fairly large and chromatic (Fig. 8). In the peripheral areas were signs of active growth. The nuclei were more deeply staining and I showed a goodly number of mitoses as well as anaplastic divisions. Here and there also were groups of less differentiated cells with scanty cytoplasm and relatively large densely staining nuclei resembling neuroblasts (Fig. 9). Specific stain revealed no ganglion cells or nerve fibers such as are found in

the normal carotid body. The rapidly growing periphery with fibrosing center, the absence of ganglion cells and nerve fibers, and the presence of numerous relatively undifferentiated cells justify the diagnosis of neoplasm rather than simple hyperplasia. What to call it is another question. The terms adenoma, perithelioma, epithelioma, etc., as will be shown are unsuitable. The term paraganglioma caroticum is preferable.

**CASE 2.** (S. Vincent 726-2.) A salesman, white, married, aged 35 years, entered St. Vincent's Hospital complaining of a swelling in the right side of his neck. The family history was of no importance. He first noticed a small mass in the right side of his neck 8 to 10 years ago but suffered no pain or inconvenience from it until 3 months ago when it commenced to grow rather rapidly and soon caused discomfort in wearing collars. Examination revealed a man in good physical condition in every respect except the above mentioned growth in the neck which appeared as an encapsulated ovoid fibrocytic mass about the size of a large egg situated under the angle of the jaw and covered anteriorly by the tail of the parotid gland. It was adherent to the great vessels apparently enclosed in the carotid sheath and like the vessel was movable laterally but not vertically. It was not adherent to the overlying skin. The external jugular vein was considerably dilated as the result of pressure.

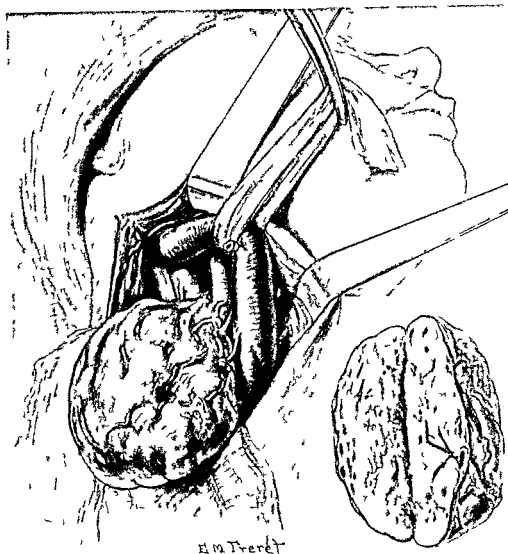


Fig 2 Case 1 Paranglioma of the carotid body

*Pre-operative diagnosis* Tumor of carotid body or aberrant thyroid. Operation was advised and accepted.

*Operation* February 18 1925 (Fig 10) An incision was made along the anterior border of the right sternocleidomastoid muscle, including the skin and platysma. The cleidomastoid muscle was dissected free and the tumor mass exposed. The sheath of the carotid was incised and the glistening capsule of the tumor presented itself. Before the removal of the tumor the internal carotid vessel and vagus nerve were identified and found in normal relation with the internal jugular vein, which was pushed well to the outside. The vessels entering the tumor capsule were carefully dissected and ligated and the tumor evacuated without rupture. All bleeding points were separately clamped and tied. The wound was closed with a subcuticular stitch and a rubber tube drain inserted in the lower angle. The postoperative diagnosis was made with reservations because of the atypical smooth and fairly regular capsule. However, the anatomical location suggested carotid body tumor.

The postoperative course in this case was not attended by any serious complication. Contraction of the pupil was present and has persisted up to the present. The patient was last seen November 24, 1926, 21 months after the

operation and no evidence of recurrence was noted. voice and swallowing were normal.

*Pathology* (Figs 11 and 12) The specimen consists of a somewhat oval shaped mass of grayish firm elastic tissue 7 by 5 by 3½ centimeters in dimensions. Section reveals a grayish white, glistening velvety surface in the peripheral three fourths with reddish to dark brown discoloration and cavitation in the center.

*Histology* Sections from the central part of the tumor show considerable fibrous replacement of the tumor parenchyma, groups of cysts developed in dilated and ruptured blood vessels and scattered deposits of hemosiderin in the fixed tissues and in phagocytic wandering cells. The tumor cells are scattered in groups arranged frequently in palisade formation around compressed blood vessels (Fig 13). The peripheral portion is quite cellular and shows the true character of the tumor. The cells are small to medium sized have little cytoplasm and as a rule deeply staining hyperchromatic nuclei—simulating cells of small round or spindle cell sarcoma. The general arrangement is alveolar the alveoli being encompassed by thin walled blood vessels. Within the larger alveoli, cell groups are arranged in typical rosette formation (Figs 14 and 15). These groups of cells surround in circular or

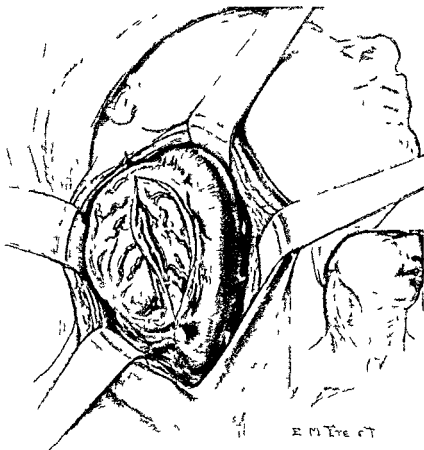


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**CASE 2 (St Vincent's 776-25).** A salesman white married aged 38 years entered St Vincent's Hospital complaining of a swelling in the right side of his neck. The family history was of no importance. He first noticed a small mass in the right side of his neck 8 to 10 years ago but suffered no pain or inconvenience from it until 3 months ago when it commenced to grow rather rapidly and soon caused discomfort in wearing collars. Examination revealed a man in good physical condition in every respect excepting the above mentioned growth in the neck which appeared as an encapsulated ovoid fibrocystic mass about the size of a goose egg situated under the angle of the jaw and covered anteriorly by the tail of the parotid gland. It was adherent to the great vessels apparently enclosed in the carotid sheath and like the vessels was movable laterally but not vertically. It was not adherent to the overlying skin. The external jugular vein was considerably dilated as the result of pressure.

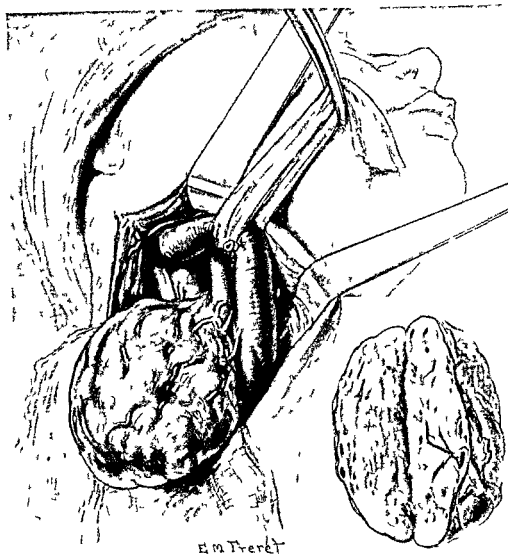


Fig Case 1 Parangloma of the carotid body

*Pre-operative diagnosis* Tumor of carotid body or aberrant thyroid. Operation was advised and accepted.

*Operation* February 18 1925 (Fig 10) An incision was made along the anterior border of the right sternocleidomastoid muscle, including the skin and platysma. The cleidomastoid muscle was dissected free and the tumor mass exposed. The sheath of the carotid was incised and the glistening capsule of the tumor presented itself. Before the removal of the tumor the internal carotid vessel and vagus nerve were identified and found in normal relation with the internal jugular vein which was pushed well to the outside. The vessels entering the tumor capsule were carefully dissected and ligated and the tumor enucleated without rupture. All bleeding points were separately clamped and tied. The wound was closed with a subcuticular suture and a rubber tube drain inserted in the lower angle. The postoperative diagnosis was made with reservations because of the atypical smooth and fairly regular capsule. However, the anatomical location suggested carotid body tumor.

The postoperative course in this case was not attended by any serious complication. Contraction of the pupil was present and has persisted up to the present. The patient was last seen November 24 1926 21 months after the

operation and no evidence of recurrence was noted voice and swallowing were normal.

*Pathology* (Figs 11 and 12) The specimen consists of a somewhat oval shaped mass of grayish firm elastic tissue 7 by 5 by 3½ centimeters in dimensions. Section reveals a grayish white glistening velvety surface in the peripheral three fourths with reddish to dark brown discoloration and cavitation in the center.

*Histology* Sections from the central part of the tumor show considerable fibrous replacement of the tumor parenchyma, groups of cysts developed in dilated and ruptured blood vessels and scattered deposits of hemosiderin in the fixed tissues and in phagocytic wandering cells. The tumor cells are scattered in groups arranged frequently in palisade formation around compressed blood vessels (Fig 13). The peripheral portion is quite cellular and shows the true character of the tumor. The cells are small to medium sized have little cytoplasm and as a rule deeply staining hyperchromatic nuclei—simulating cells of small round or spindle cell sarcoma. The general arrangement is alveolar, the alveoli being encompassed by thin walled blood vessels. Within the larger alveoli cell groups are arranged in typical rosette formation (Figs 14 and 15). These groups of cells surround in circular or



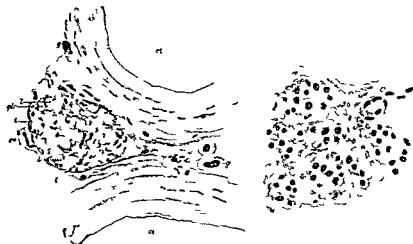


Fig 4. Normal carotid gland. At left section near the bifurcation of the common carotid gland (Marchand). Somewhat magnified. *ci c* internal and external carotid arteries cut across *g* carotid gland *g* blood vessel *i* interstitial connective tissue of gland *l* glandular lobules or nodules. At left section of part of the carotid gland (human) showing the epithelium like cells of which the glandular nodules are composed (Schaper). Highly magnified. Numerous blood vessels are seen in section among the gland-cells (from Quain's *Anatomy*).

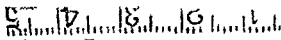


Fig 3. Case 1. Paraganglioma of the carotid body gross specimen.



Fig 5. Normal carotid gland. Diagrammatic view of the disposition of the blood vessels in a nodule of the carotid gland (Schaper). *a* Arteriole entering nodule *v* veins leaving nodule *v* veins in connective tissue around nodule *l* enlarged capillary within nodule *b* epithelium like cells of the gland *c c* boundary of nodule abutting upon lymph spaces *d* interstitial connective tissue of gland (from Quain's *Anatomy*).

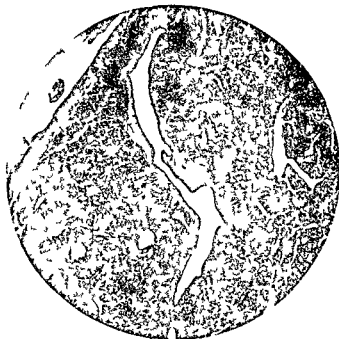


Fig 6 Paraganglioma of the carotid body Low power of central portion showing thick fibrous walls of blood caverns Low power

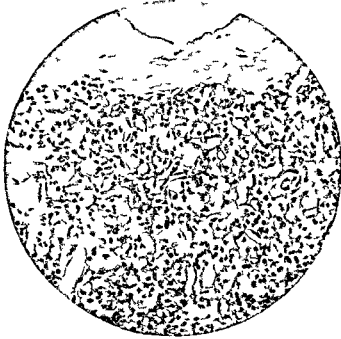


Fig 7 Paraganglioma of the carotid body High power of section shown in Figure 6 showing fibrous walls of blood caverns

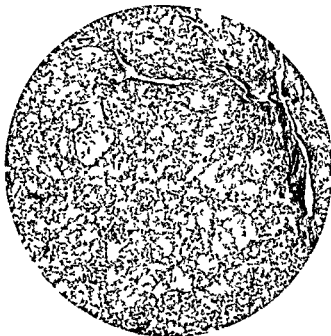


Fig 8 Low power of peripheral portion of paraganglioma showing active growing alveoli with thin walled blood vessels

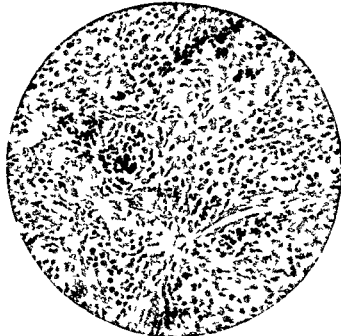


Fig 9 High power of Figure 8 showing actively growing undifferentiated cells with hyperchromatic nuclei

ovoid fashion fine fibrillar areas which stain light pink with eosin yellowish brown with Van Gieson and Biel chowski stains and do not take any of the specific stains of collagen elastic fibroglia or neuroglia fibers. The fibrillar structure is evidently not an extracellular product like collagen but a direct extension of the cell cytoplasm which not infrequently emerges from the cell groups in a brush like arrangement as is shown in Figures 14 and 15. The cells

and their arrangement are of the type seen in neuroblastoma. The fibrils may be poorly formed naked axis cylinders or they may represent merely the cytoplasmic extensions of the capsule or Schwann sheath cells.

*Diagnosis* Neuroblastoma of the carotid body

The question of carotid body tumors has been so frequently and thoroughly discussed that a

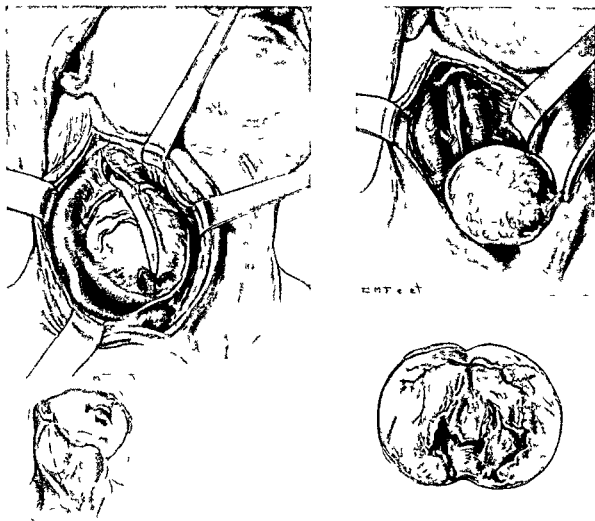


Fig 10 Neuroblastoma of the carotid Gross drawing

repetition seems unjustifiable unless in the way of corrections based on the most recent reports information contributed from further study or reference to points emphasized in the particular cases here reported

*Morphology of the tumor* There can be little question that the carotid body represents one of the paraganglia of the sympathetic nervous system of which for instance the medulla of the adrenal gland is another and the best known. In Figure 16 representing the genealogy of these structures it will be seen that there are several resting or rearrangement stages in the differentiation of the neuro ectoderm on its way to form the ganglia and paraganglia of the sympathetic nerve system. It is a fact that these resting

stages tend to give rise to neoplasms and the most acceptable as well as most scientific way of naming these growths is by referring to the stage of origin. Thus we have well defined cases of ganglioneuroma paraganglioma or chromaffinoma and neuroblastoma.

There will be little difference of opinion in regard to naming our tumor in Case 1 a paraganglioma since it is a more or less typical reproduction of the structure of the normal carotid body. (Compare Figs 4 and 5 with Figs 8 and 9.) The only question which might arise would be as to whether the mass is a true neoplasm or hyperplasia like that of the thyroid in exophthalmic goiter. Probably both conditions do occur but there are strong evidences such as the



Fig 11 Case 2 Neuroblastoma of the carotid



Fig 12 Neuroblastoma of the carotid

central degeneration and peripheral growth mentioned above, that in this case as well as in many of the cases reported in the literature, we are dealing with true neoplasm. Our second case represents a very different type of carotid tumor, cases of which have been reported from time to time and of which the interpretation and diagnosis are by no means as certain. This type has been interpreted by different authors under such names as endothelioma, sarcoma, sarcoma like tumor, psuedo sarcoma, etc (5, 6, and 8). A study of a number of such cases reported in the literature reveals a striking similarity in their morphology to that of our Case 2. It is our suggestion that this group of carotid body neoplasms, which not infrequently show malignant infiltration and destructive qualities, are really neuroblastomata, sympathoblastomata, or generally neuromata, and not tumors of fibroblastic or endothelial origin. Such neoplasms arise most commonly in the adrenal gland but have been described as occurring in other regions of the sympathetic distribution. Three cases were recently reported by Boyd (4) and 2 by one of us (Fraser, 9). Two of these cases originated from the adrenal medulla, 1 from the retina, 1 from the abdomen, and 1 from the thoracic sympathetic system. The adrenal medullary tumors originate in undifferentiated neuroblasts which are frequently present in the normal gland, and as such undifferentiated cells have been described in the normal carotid body it is only natural to expect that similar neoplasms would develop there.

#### DIAGNOSIS

The clear cut points of differential diagnosis given by Keen (12) and recently summed up by

Klose (13)—location at the carotid bifurcation, good lateral and poor vertical mobility, ovoid form with smooth uneven surface, firm elastic consistence, expansile pulsation with systolic bruit, both disappearing with compression of the carotid, bulging of the pharynx wall with paralysis of vocal cord, myosis on affected side, slow growth and long duration without pain—theoretically ought to make diagnosis easy. But as a matter of fact, it is difficult, a good proof of which is that very few of the 100 or more recorded cases were diagnosed before operation. The apparent discrepancy is due to the fact that in advanced cases the tumor has so infiltrated and grown around the vessels that many of these diagnostic points cannot be elicited. In the cases here reported the characteristic relation of tumor to vessels was not distorted and the great importance of this factor in diagnosis is once more illustrated. Mont Reid (15) regrets the apparent neglect of this as the most helpful point in differential diagnosis. He says, "Thus, what ought to be a great help in the differential diagnosis of these tumors is touched upon very lightly in the literature. I know of no other growth of the neck which catches fixes, and carries the carotid artery with it. Enlargement of the lymphatic glands usually leaves the artery in its course or perhaps rolls it a little anteriorly or posteriorly. Large benign thyroid conditions always throw the carotid artery posteriorly, so that in large colloid goiters it may be felt as a freely movable vessel and not far from the midline of the neck. Malignant thyroid tumors may invade, but do not distort, the course of the common carotid artery. So branchial cleft cysts, hygromata and other benign tumors of the neck may roll the

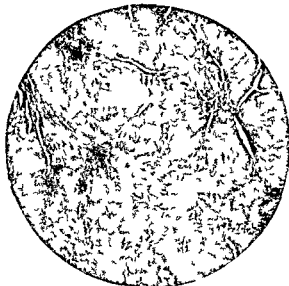


Fig 13 Low power of central portion of neuroblastoma of the carotid body showing general alveolar arrangement



Fig 14 Case 2 Low power of peripheral portion of neuroblastoma showing rosette formation

artery so that it becomes a slightly displaced freely movable vessel

#### TREATMENT

Treatment can only be surgical. Radiation with the X rays and radium is without permanent results (Birman). There is a difference of

opinion as to the justification of operation in individual cases. On account of the previously high mortality rate 27 to 30 per cent, Reclus and Chevassu (14) as well as Keen have recommended surgical intervention only when severe trouble or rapid growth with malignant appearance occurs. Royster (16) Balfour (2) Da Costa (8) and others on the other hand recognizing that the fatalities and postoperative disabilities as well as the recurrences were largely the result of the extensive resection of the vessels and nerves necessary in advanced cases have urged that operation should be performed as soon as possible since only then is there any prospect of cure. Winslow (18) also recommended early extirpation. And according to Collier (15) Keen later adopted this view. The fact that both tumors here reported showed signs of active growth and possible malignant tendencies together with the fact that now for several months both patients have been free from all symptoms can be regarded as a further vindication of surgery.

#### DISABILITIES RESULTING FROM OPERATION

Postoperative disabilities have occurred mostly in advanced cases in which resection or injury to the vessels or nerves was unavoidable. Pneumonia, hæmorrhage, cerebral anæmia and infection are given in the order of their importance as the causes of death, pneumonia being the most important. It is thought that the frequency of pneumonia may be explained as resulting from

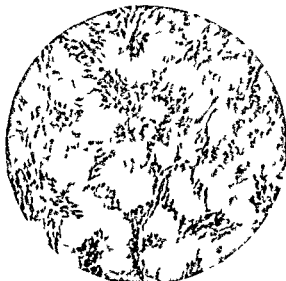
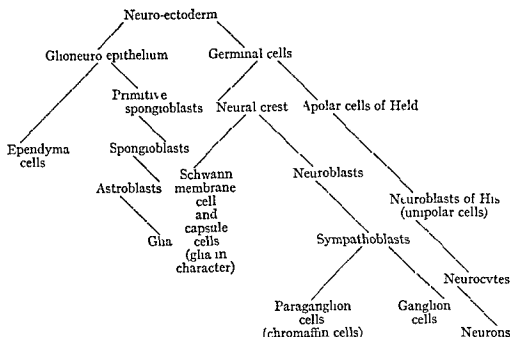


Fig 15 High power of Figure 14 showing groups of neuroblasts surrounding fibrillar network. In light areas the little fibril (brush like) can be seen distinctly (Van Gieson stain)

Fig. 16 Genealogy of the nervous system<sup>1</sup>

lowered resistance of the lung following section of the vagus. The control of hæmorrhage, operative and postoperative, constitutes the most difficult problem connected with the treatment of these cases, as was illustrated in the handling of our Case 1. A glance at the photograph and drawings of the gross specimen (Figs. 1, 2, and 3) in this case will explain why this is so. The mass is honeycombed with blood caverns which stand wide open and communicate with corresponding tributary branches from the large vessels. The walls of this vascular network are densely fibrous and hyalinized so that they can be compressed with great difficulty. Death or paralysis due to cerebral anæmia may be lessened, according to Halsted (quoted by Mont Reid, 15), by previous compression of the carotid with a metal band. Burman (3) recommends ligation of the vein together with the artery in the hope that the blood congestion may protect against softening of the brain. Embolism affecting either hemisphere has been observed. Aphonia without vocal cord paralysis may occur, as in our Case 2. This is probably due to the muscular œdema following trauma sometimes observed in operation for goiter. Recurrences have followed cases in which infiltrating tumors have been dissected from the vessel wall.

#### CONCLUSIONS

1. Two cases of true neoplasm arising from the carotid body have been presented, representing

two different types of growth described in the literature.

2. It has been shown that one of these (Case 2) is a case of neuroblastoma and evidence has been found for the suggestion that at least some of that group of carotid tumors vaguely described as sarcoma like, endothelioma, etc., are of the same nature, that is, neuroblastomata or other varieties of neuroma.

3. Both types of carotid body neoplasm, paraganglioma and neuroblastoma, especially the latter, may become malignant, and as the early stages of growth constitute practically the only favorable time for operation, early extirpation is recommended.

4. The control of hæmorrhage, operative and postoperative, constitutes the most difficult problem connected with the treatment.

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## AN OPERATION FOR EXTRA-ARTICULAR FUSION OF THE SACRO-ILIAC JOINT

BY WILLIS C CAMPBELL M D F A C S MEMPHIS TENNESSEE

**A**RTHRODESIS fusion, or the induction of osseous ankylosis of the sacro iliac joint is indicated for tuberculosis and certain other affections of that joint for which there are several well known methods. In these operations however the sacro iliac joint may be entered and secondary infection made possible. This infection may prove most annoying as a discharging sinus, if not a fatal complication. Recently I have employed a simple operation entirely extra articular, thus avoiding any possibility of contamination within the joint.

In a skeleton the dorsum of the ilium will be seen to extend over the posterior aspect of the sacrum forming a gutter or triangular space with the sacrum. The object of this procedure is to fuse or induce osseous union between this overhanging portion of the ilium and the posterior surface of the sacrum and thus to cause extra articular ankylosis posterior to the joint. The technique is as follows.

An incision is made along the outer lip of the crest of the ilium from the posterior one third or one half to the posterior inferior spinous process



Fig 1

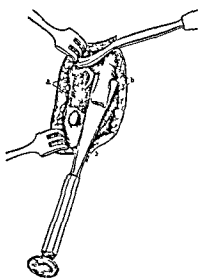


Fig 2

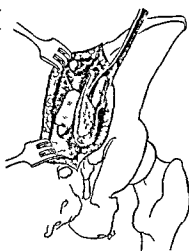


Fig 3

Fig 1 Exposing outer half of posterior surface of sacrum and posterior half of crest of ilium. *a* Inferior articular process of fifth lumbar vertebra. *b* superior articular process of sacrum. *c* sacrospinous lig (retracted). *d* posterior superior iliac spine. *e* posterior inferior iliac spine.

Fig 2 Removal of a portion of crest of ilium. *a* De-

nuded surface of sacrum. *b* denuded surfaces of ilium. *c* large bone chip or graft being removed from crest.

Fig 3 Placing multiple chips into denuded gutter formed by posterior surface of sacrum and inner surface of dorsum of ilium. *a* Multiple chips from lateral surface of ilium placed between ilium and sacrum. *b* large bone chip placed between the sacrum and ilium.

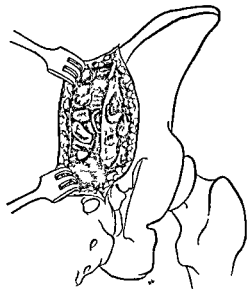


Fig 4 Multiple grafts completely filling the denuded gutter

(Smith Peterson) This is carried down to the bone, where the periosteum is incised and elevated for a considerable distance, and the posterior portion of the dorsum of the ilium exposed. The crest of the ilium is dissected free to raw bone and the adjacent fibrous tissue removed from the posterior surface of the sacrum beneath the region of the erector spinæ, or sacrospinal muscle. A portion of the crest is removed and placed in a towel. The inner surface of the overhanging portion of the crest of the ilium is denuded, and a raw gutter made parallel with the sacro iliac joint, formed by the posterior surface of the sacrum and the inner surface of the ilium posterior to the sacro iliac joint. Into this space is placed the graft from the crest. Multiple grafts or "shavings" are next secured from the dorsum of the ilium and placed



Fig 5 Showing fusion between sacrum and ilium posterior to sacro iliac joint a, Bony fusion

into the gutter until the space is well filled, when the wound is closed in layers. The patient is placed on a Bradford frame for a period of 6 weeks, when a low back brace with sacro iliac belt is applied.

This method has been used in 7 cases to the present time, in 5, the results are apparently satisfactory, and pain has been entirely relieved. The procedure in Case 2, however, was in conjunction with a fusion operation of the spine, in which a portion of the crest of the ilium was transplanted into the spinous processes, after the manner of Albee. The crest of the ilium conforms to the normal lumbar lordosis in this region.

In 2 cases sufficient time has not elapsed to determine the effect of the procedure.



# INJURIES TO THE MENISCI AND THE LIGAMENTUM MUCOSUM COMMONLY CALLED INTERNAL DERANGEMENTS OF THE KNEE JOINT

By WILLIAM R. CUBBINS, M.D., F.A.C.S. AND ARTHUR HOBART CONLEY, M.D. CHICAGO

**I**NTERNAL derangements of the knee joint are defined as peculiar conditions in the knee joint variable in appearance variable as to cause variable as to degree of disability variable in the extent of the lesion and variable in treatment. From this definition it is obvious that the terminology is archaic and impossible. It is therefore time to correct this indefinite nomenclature and to seek to learn as early as is possible the fundamental facts concerning etiology.

This paper will deal with injuries to the medial meniscus the lateral meniscus and the ligamentum mucosum. These injuries are chosen because they are the most difficult to demonstrate with the X-ray and most difficult to diagnose under ordinary conditions.

Each of these conditions is a definite entity and each in my opinion probably has very definite causes. We have used the plural in order to stress the direct and indirect causes although in its immediate relation to the cartilage the cause is always direct in relation to the joint it may be direct and indirect. That is a sharp body may strike the joint in such a manner that the cartilage or ligamentum mucosum is injured (fractured or dislocated). This should be called a direct cause. On the other hand when the cartilage is injured between the ends of the bones forming the joint this trauma could be called indirect although this would not cover the facts.

It would seem to me that our knowledge of the mechanics of these injuries is not as complete as it might be because we have failed to learn from the patient the actual position of the limb at the time of injury. It must be granted that 75 per cent of the injuries occur under such circum-  
stances as to make impossible for the patient to remember the actual position of the joint and limb at the time of injury. However of the remaining 25 per cent there should be a sufficient number of patients who are able to give accurate etiological data. Attempts to produce these lesions upon the cadaveric joint have probably been rather extensive but no available reports of success could be located due to the fact probably that great force accompanied by rapid extension, is necessary to produce the lesion.

The history of direct force causing the lesion is common and has been proved many many times. But these direct injuries are not the ones which present a cloudy picture and compel us to take refuge in the vague term internal derangements of the knee joint. It is the injury to either the outer or inner meniscus that comes with what appears to be a small amount of force. Yet when we analyze this so called small amount of force we find that both great force and rapidity of action have characterized the movement causing the condition. We underestimate the force because of the weight of the body and the leverage required to handle it under a strain. Therefore in my opinion an accurate diagnosis should be made of injury to the medial meniscus injury to the lateral meniscus or injury to the ligamentum mucosum and not use such a vague term as internal derangement of the knee joint.

## ETIOLOGY

*Injuries to the medial meniscus* 1. Direct trauma. The direct cause of injury to the medial meniscus may be a fall upon the knee striking any sharp edge such as a curb an auto bumper an auto fender a fence rail the edge of a manhole the edge of a chair or the pole of a wagon or, in football a blow on the joint with either the toe or the heel of a shoe.

2. Indirect trauma. In indirect trauma as stated above the knee is subjected to a great strain with in my opinion a sudden extension. Some authors state that this must be accompanied by an inward rotation of the leg on the femur others that it must be accompanied by a lateral rotation of the leg on the femur. These mooted points will be settled only after a careful analysis of hundreds of cases and it is possible it will be found that the injury to the medial meniscus can occur with either an inward or an outward rotation. Just exactly what effect is produced when the semimembranosus pulls the medial meniscus out of its position under a heavy strain has not been determined but we know that semimembranosus is definitely and firmly attached to this meniscus and this attachment of the tendon gives the most plausible explanation

yet presented for the frequency of the injuries to the medial meniscus. If the leg is rotated outward, this tendon will be subject to a greater tension and might press the meniscus deeper between the bones, so that it would be much more liable to be trapped upon sudden extension.

In the normal joint there is also a greater exposure of the anterior portion of the medial meniscus superficial between the patellar tendon and the internal lateral ligament, than of the lateral meniscus. However, if there be some genu valgum, the medial meniscus is still more exposed and probably more subject to injury. This factor has not been stressed sufficiently by other authors, but it seems to me to be worthy of serious consideration.

*Injuries to the lateral meniscus.* Injuries to lateral meniscus are not common, different authors having placed its incidence and that of injuries to the medial meniscus in the ratio of one to twelve or one to fifteen. We have had three of these cases. One patient received an injury while turning a handspring. As is well known, in this position one lands on the semiflexed extremities with the legs as a rule rotated outward, and he immediately jerks himself into an upright position. This young man stated that he landed all right, but as he straightened himself, the pain was excruciating and threw him to the floor. The mechanics apparently was that as the elastic ends of the bones came together under the heavy blow of the landing, the convexity of the femur was flattened, the concavity of the tibia increased, just as you would expect any two elastic substances to act. Thus was produced a broader surface of contact, and the cartilage was caught between these broadened surfaces and fractured, the subsequent extension serving as the dislocating factor. This apparently was accomplished with the foot slightly everted, and yet there was no chance of the cartilage being pulled out of its place by tendon insertion.

In another case no definite history was given. The history showed merely a chronic arthritis, with an occasional locking and pain in the outer side of the joint over the meniscus. The other case in this series was one of direct trauma, the knee having been struck on the edge of a manhole. From the facts in the first case, it would seem that the elasticity of the joint surfaces was so great that broader surfaces came in contact with the meniscus, and in this manner it was caught and fractured.

*Injuries to the ligamentum mucosum.* Here we have instances of both direct and indirect trauma. As a rule, the trauma is directly in front

of the joint, over a relatively broad surface, and apparently must be associated with a certain amount of relaxation in the patellar ligament. One of our cases was that of a soldier with an indefinite history, but with a very marked enlargement on each side of the patellar tendon. Another case was that of a football player, with small, semidetached fragments of the ligament between the medial condyle of the femur and the tibia. In both of these cases a rather severe hemorrhage had accompanied the injury. In one, a lowered coagulation of the blood was a definite factor.

#### PATHOLOGICAL ANATOMY

The same changes are found in both menisci, that is in fractures and dislocations, or fractures with dislocations. These fractures may be transverse to the arc of the meniscus, oblique, or longitudinal. In other words a fracture occurs which is almost circular in type, separating a thin strip of the meniscus from the portion which is attached to the joint edges. This latter type of injury has been called by Rutherford Morrison the bucket handle deformity, relating to an old type of leather bucket used in England, but seldom seen in this country. The dislocations of these menisci are usually associated with fractures. But, if the joint is operated upon early a pure dislocation is sometimes found. We have had two of this type of injury. The cases may be divided into three classes.

- 1 Cases in which the anterior portion of the medial meniscus is torn loose and dislocated backward.

- 2 Cases in which there is a dislocation of that portion of the medial meniscus which lies midway between the patellar ligament and the internal lateral ligament, the detachment remaining firm at its anterior portion and at the insertion of the internal lateral ligament.

- 3 Cases in which there is a dislocation of the entire medial portion of the ligament, forcing it into the notch between the condyles, the anterior and posterior detachments being the only points of fixation.

It is obvious that if this dislocated ligament is subsequently subjected to serious trauma, we have fragmentation and fraying as an immediate sequence.

The only dislocation of a lateral meniscus that we have encountered was in the man who had turned the handspring. But, as he had suffered subsequent injuries to the joint in attempting to play football, it is not possible to state that it occurred as a result of the handspring.

The pathological changes in the ligamentum mucosum vary from a tearing and dislocation of small fragments between the ends of the bones to a marked hypertrophy elongation with destruction of the blood supply, and gangrene of the hypertrophied mass. On the whole there is very little in the literature concerning the injuries to this structure. In one of our cases the meniscus was a gangrenous mass  $2\frac{1}{4}$  inches long by 1 inch in diameter.

*Concomitant changes* in the joint should be divided into three types and described under the heads of *immediate*, *mediate*, and *late* as the pathological anatomy of each type is rather marked. In the immediate type we have an extravasation of a synovial fluid that is relatively thin and of a light straw color. This fluid grows thicker and more stringy in from 5 to 10 days and may become almost viscid at a later period when most of the fluid has been reabsorbed. Far more frequently than is realized free blood is also present in varying quantities. As to whether blood alone will irritate a joint without the presence of another irritant we are not certain. But it does seem that blood in sufficient quantity to cause immediate swelling and distention is an irritant of a severe type. It apparently increases the pain, prolongs the time of absorption and produces a greater reddening of the synovia. Our experiments with aseptic blood in the peritoneal cavity seemed to show that it was non-irritating but the presence of the least infection rapidly changed the picture and made it a dangerous foreign body which frequently caused death in the experimental animals. It may be merely the mechanical distention of the joint with stretching of the synovia that causes the greater pain increased sensitiveness and prolonged healing.

The intermediate stage begins about the seventh day when the synovial membrane is reddened and swollen with some oedema in the extrasynovial or overlying tissues. The synovia is wrinkled as the fluid escapes from the joint. After the above condition has lasted a variable time the length of which we are not able to estimate with continued insults to the joint from the fractured or dislocated cartilage other changes make their appearance. These are a still greater thickening of the synovial membrane even to a papilla formation. There is also a relaxation of the joint ligaments due to the long continued oedema beneath them, also a stretching of the tissues with each succeeding strain as the fragment is caught between the articular surfaces or the joint tries to accommodate itself to the

strain of locomotion in the presence of excessive fluid.

These same factors are also instrumental in forcing the fluid into the peri articular bursa more particularly those posterior to the knee. One of our cases presented an immense popliteal bursa between the head of the gastrocnemius and the biceps tendon which was part of an arthritic syndrome without definite etiology. As it was the immediate cause of complaint it was removed first. However as the knee continued to cause trouble an exploratory incision was made and a dislocated much injured cartilage was found and removed. This gave a good result in that the patient was free from pain but the joint remained a little loose and unstable.

The fourth change is a bony proliferation around the edges of the femoral articular cartilages. These changes were present in one case 18 months after the initial injury but following many subsequent injuries. They were present to a marked degree in the case just cited. Whether under the continued stimulation of repeated trauma they would grow large enough to become detached and form free bodies in a joint we do not know but it certainly seems to be a possibility.

During repeated attacks fluid varies little from what has been stated above but as a rule the patient giving a history of a fractured or dislocated cartilage causing trouble without an increase of the fluid in the joint with each insult must be carefully watched. A history of pain and locking can be glibly given but fluid in the joint is not so easily simulated. In very old cases or those with little injury there may be fluid present that is not demonstrable but as yet they have not been seen in our service. In other words here we have a chronic diffuse arthritis the result of pure trauma from an agent that could be easily removed if it were correctly diagnosed in the early stages. That we may have a superimposed infection by the hæmatogenous route upon these changes is perfectly obvious but it is our opinion that the removal of the cause will obviate many of these chronic joints.

#### SYMPTOMS AND SIGNS

All three types of injuries are characterized by *Pain*. This is always present when the cartilage or ligamentum mucosum is under pressure between articular surfaces. At the onset this pain is of an exquisite type and renders the limb immediately useless the patient frequently falling to the ground helpless. Later after many attacks it is of less severity and, in some instances the patient is able to get around and be fairly

useful, although there is a small piece of the cartilage between the articular surfaces. This is true, more particularly after the ligaments are relaxed and there is some excess fluid in the joint. But, it must be remembered that during this period of semi usefulness, a chronic arthritis is developing.

**Locking** Locking is due to the fractured cartilages getting between the ends of the tibia and the femur and is the actual cause of the pain described. Actual locking has occurred in about 75 per cent of our cases. Pain of a severe type can occur, however, without an actual locking. It is difficult to elicit this history of locking from an ignorant patient, but while it is at times difficult to elicit a history of locking the malingerer rarely ever thinks to mention such a condition. The intelligent man can tell exactly in what position the joint is fixed, what position causes it to be fixed, and what particular motion will free it. Complete locking will occur in about 50 per cent of the cases with a clear history. *Partial locking* or hindrance to motion (the patient always meaning a hindrance to the extension of the joint or leg) occurs in as high as 75 per cent of the cases.

**Tenderness** Tenderness has been one of the most valuable points in diagnosis in our series, and it seems to us that too little attention is given to this valuable finding. The most startling thing is the evident ease with which the patient is able to locate and demonstrate the tender point, after the initial insult and the diffuse tenderness which accompanies it has disappeared. This has been so definite that of late we have been trying, perhaps fruitlessly, to diagnose the point of fracture or the amount of dislocation by variations in the location of the point of greatest intensity. It has seemed that in fractures of the medial meniscus, in which the injury is midway between the patellar and internal lateral ligament, the tenderness is directly over that point. In one instance, in which the medial meniscus was torn free from the attachment at the tibial spine around to the internal lateral ligament, the point of greatest tenderness was where the meniscus was dragging upon its point of attachment. In another case, in which there was a fracture well back in the lateral meniscus, the tenderness was over the point of rupture. When injury to the ligamentum mucosum is present the tenderness is on each side of the patellar tendon. This fatty pad is rather prominent in children who are constantly on their knees and this fullness has less significance in children than in adults. But, definite tenderness of the mass must arouse suspicion of

its injury. The tenderness behind the joint seems to be due to a stretching of the posterior ligaments when a portion of the meniscus is between the joint surfaces. With a piece of cartilage chronically out of place, this is a common complaint, but, it is always diffuse and can never be definitely located. All in all, it must be emphasized that these points of tenderness are best elicited after the acute inflammation has subsided.

**Swelling of the joint** A history of swelling in a joint of this type is practically always present, it comes on suddenly and remains from 5 to 15 days. The absence of a history of swelling in a patient who claims to have a locking of the joint is extremely suggestive, and when it occurs one must be very careful about making a diagnosis of a cartilage injury.

#### DIAGNOSIS

**General symptoms** The temperature is variable, ranging from 99.2 to 100.4 degrees F. in this series. The pulse also varies from 80 to 100, with the severity of the pain. Collapse has been noted, although it was not present in any of our cases. The leucocytosis is also somewhat variable. As a rule it was around 8,000 in our series, in one case with a large hæmorrhage reaching 16,000.

**X ray** X ray pictures of these injuries are usually negative, but occasionally the report of a dislocation is made by the radiographer and verified by operation. Irvin Balensweig, of Cornell University, reported in the August, 1924, number of SURGERY, GYNECOLOGY and OBSTETRICS, a very interesting case of a pneumarthrosis in which he distended the joint with oxygen and in that way succeeded in demonstrating a loose piece very clearly. It seems to me that with this method a great deal can be accomplished and that it deserves further trial.

**Manipulations** Sometimes it is well worth while to make certain manipulations in an attempt to trap the cartilage and cause a locking. If the locking can be obtained, of course the diagnosis is positive. This, however, is extremely difficult to do and we must content ourselves most of the time with clicking and catching, which the patient will immediately identify as similar to the condition which cripples him, both in relation to the pain and to the position. These manipulations are carried out in the following manner. With one hand grasping the foot around the instep, the other hand, or that of an assistant, steadying the thigh, the leg is flexed on the thigh. The leg is slowly extended on the knee joint, while the foot is held everted. If this is not successful, the foot and leg are rotated inward and the same

motions are gone through. This is successful in probably 10 per cent of the cases.

*Aspiration* Aspiration is very valuable and should be used in all cases in which there is a doubt as to the diagnosis. It acquaints one with the character of the fluid and the fluid can be stained for tubercle bacilli or cocci and guinea pigs can be inoculated to rule out the possibility of tuberculosis. In addition aspiration gives a feeling of comfort and relief to the patient.

The diagnosis is as a rule clear and distinct if the history of the mechanics, the point of tenderness, the locking and the character of the fluid is carefully noted. It can be confused with rupture of the crucial ligament but as a rule the degree of force required to rupture a crucial ligament is so marked that one is not led to think of injuries of the menisci. Injury to the crucial ligaments is usually due to direct force and a large amount of preternatural mobility is present in the joint. The tibia moves laterally and antero-posteriorly with far greater freedom than normally. That the cartilages may be injured at the same time goes without saying but they are overshadowed by the more severe injury of luxation or subluxation of the knee joint. If a patient comes in later the X ray may show a proliferation around the spine of the tibia. Our cases of ruptured crucial ligaments have been associated with an evulsion of the tibial spine instead of a true rupture of the ligament although there are reported in the literature a great many ruptures of the crucial ligaments in which no mention is made of the tibial spine.

#### RUPTURE OF THE INTERNAL LATERAL LIGAMENT

Rupture also requires great force and practically always involves the internal lateral ligament as the force is applied to the outside of the knee. The tenderness is more diffuse there is a marked swelling of the tissues below the joint and it is accompanied by a severe discoloration due to a subcutaneous ecchymosis. The X ray may show an evulsed portion of one of the bones entering into the formation of the joint.

#### JOINT MICE

The typical joint mouse is usually seen in a notch in one of the condyles. It can be shown rather definitely with the X ray.

Joint mice that accompany a proliferative arthritis usually occur in elderly patients and in my opinion may follow a dislocated or fractured cartilage, upon which has been superimposed a hematogenous infection. The mice are as a rule, easily shown with the X ray.

#### CHRONIC INFECTIVE ARTHRITIS (PROLIFERATIVE IN TYPE)

In a chronic infective arthritis condition we have an absence of locking early and almost continuous diffuse tenderness. Seldom is there a history of definite injury, but always a history and concomitant findings of infection elsewhere in the body.

*Tuberculosis* Tuberculosis is characterized as a rule by a more diffuse tenderness with an almost complete loss of function. Any attempt at moving the joint is bitterly resented. No history of locking is present. There is greater atrophy both above and below the joint but the final determination of the diagnosis lies in aspirating and in making stained specimens of the fluid and guinea pig inoculations. Many times the X ray gives positive evidence of an early tuberculous change.

#### SYPHILIS

Syphilis as a rule comes on relatively slowly. There is no definite point of tenderness. The tenderness is seldom very severe and the amount of fluid is variable. But the final absolute test must be made with therapeutics. The Wassermann is of aid provided we have several tests, each running four plus.

#### PROGNOSIS

The prognosis is excellent if the operation is carefully performed. There need be no limitation of motion, no increased mobility and no weakness following operation. Men can and do resume their occupations at football, baseball, or any other necessary labor.

#### TREATMENT

Treatment is better divided into three types: immediate, palliative and operative.

*Immediate treatment* The joint should be completely immobilized at once. This saves pain and discomfort and limits the extravasation of fluid. If the fluid is excessive it should be aspirated with a large needle. This gives great relief and, if hemorrhage is present, lessens reaction in the joint. Hot and cold compresses alternated are of value. At the end of 2 or 3 days, passive motion and light massage may be instituted. Walking with the aid of crutches or cane can be resumed within 2 or 3 weeks.

*Palliative treatment* The use of braces, elastic stockings, and medication have served only to delay healing in the cases in which we have been interested and as near as we have been able to determine have not been of any value whatever.

*Operative measures* The limb is made bloodless with a Martin band and a tourniquet. A longitudinal incision, about 3 inches long, parallel to the patella, either medial or lateral, has been ample to care for any injuries to the menisci and ligamentum mucosum which have occurred in our series. It has not been necessary to make a transverse incision in the joint capsule at any operation for meniscal injuries, the retractor serving to keep the tissues away in a perfectly satisfactory manner. Splitting the patella in these cases, particularly if they happen to be of industrial cases, adds to the partial permanent disability in the leg, because it is nearly always followed by a thickening of the patella, which is easily demonstrated and gives the arbitrator an exaggerated idea of the partial permanent disability remaining. The knee is flexed over the end of the table and, if the operation is done under local anaesthesia, the patient can manipulate his own knee under direction. If operation is done under general anaesthesia, an assistant can rotate the foot outward, at the same time abducting the leg to show the medial meniscus, and rotate the foot inward, adducting the leg to show the lateral meniscus. When the joint is open, the character of the fluid, the condition of the synovia, the crucial ligaments, and the menisci are carefully inspected. Also a search is made for any particles that may have become detached. In our opinion, looseness of one of the menisci is sufficient indication for its removal. Formerly we had the idea that unless there was a fraying and

fragmentation of the meniscus, operation was not indicated, however, we have had to withdraw from that position. The removal is best accomplished by detaching the tip of the medial meniscus near the spine of the tibia, freeing it laterally and posteriorly as far as is possible, and amputating with a small, sharp tenotome.

The same procedure can be carried out in relation to the lateral meniscus. If the ligamentum mucosum is enlarged and thickened, or torn and frayed, as much of this as is necessary can be removed. It seems to us that the total ablation of this fatty ligament will leave a certain amount of disability in some cases and, under the circumstances, we feel that it is better to handle it with care.

*Closure* The serosa is sutured with fine catgut, and then the fascia in a similar manner. The skin is closed. Interrupted sutures are ample and will allow a slight escape of fluid, which does not do any harm and may wash out some of the dirt that has been left in. Voluminous dressings are applied and the part is bandaged firmly for the haemostatic effect, but this bandage must be loosened at the end of 5 or 10 hours. Otherwise, the swelling may be so severe as markedly to lower the resistance of the joint and even cause gangrene under certain conditions. No extension should be applied. The leg is merely put in a flexed position over pillows. Wheel chairs are allowed in 10 days. The patient may walk with crutches at the end of 2 or 3 weeks and resume his occupation in 6 weeks.

## REPAIR OF VESICOVAGINAL FISTULA PRESENTATION OF A NEW INSTRUMENT

By HUGH H. YOUNG, M.D., F.A.C.S., BALTIMORE

From the J. M. Buch. Dr. J. U. log. 11. 11. J. H. H. pk. s Hospital

THAT the vesical approach in the operative cure of vesicovaginal fistula is not infrequently unsuccessful is evidenced by the fact that in many cases multiple operations have been carried out without a cure of the fistula. The fact that the case I am reporting was subjected to eleven operative attempts to repair the fistula is offered as an excuse for presenting this single case with brief report of the operative technique employed to cure the fistula.

Mrs. M. C. aged 31 married entered my service of the Johns Hopkins Hospital on May 25, 1916 complaining of a vesicovaginal fistula. The family history and past history were negative. Menstruation began at the age of 14 and was quite normal. The patient was married at the age of 27. In January, 1913, she thought she was pregnant the

abdomen gradually increased in size and at the end of 3 months the vomiting which had been present for some time became so serious and was associated with so much pain in the abdomen that a diagnosis of appendicitis was made and an appendectomy carried out. This was followed by a cessation of the vomiting but it later returned and her physicians determined to interrupt the pregnancy. When this was attempted it was discovered that a mistaken diagnosis had been made that no pregnancy was present simply a hydatid mole. This was removed but during the operation the bladder was opened accidentally and since then a vesicovaginal fistula has been present. During the past 3 years the patient has been subjected to 11 operations through the vagina in an attempt to close the fistula. No details are furnished as to the technique employed but the final result was that the patient still had the fistula and wore pad which were kept constantly wet. Her general health was excellent. There had been no pregnancies. There was no evidence of renal impairment.

Examination showed the patient to be a well developed well nourished woman apparently in no pain and suffering only discomfort from being constantly wet as a result of the vesicovaginal fistula. There was a small scar on the abdomen in the right iliac region (from appendectomy) and a long broad scar extending from the umbilicus to within 2 inches of the pubis (uterine operation). On vaginal examination one felt high up slightly to the right of the median line on the anterior wall of the vagina an area of induration in the center of which a slight depression was made out. The uterus was apparently negative. A No. 24 cystoscope entered with ease and about 10 cubic centimeters of clear urine were evacuated. The bladder capacity on forced distention was 300 cubic centimeters. The tonicity was good. Study of the vesical orifice showed a slight irregularity in the mucous membrane with some edema. The trigone was much distorted. Running forward and outward from the right side of the trigone was a peculiar band of tissue which was entirely separated from the bladder wall except at its upper and lower end, the bridge being entirely covered with mucous membrane. Beneath this band was the opening of the vesicovaginal fistula. By changing the position of the cystoscope appropriately it was possible to see the fistula either from the outer or inner side of this bridge which spanned its orifice. The ureteral orifices could not be definitely made out but it was thought that the right orifice was in close proximity to the fistula which lay in the right half of the bladder about 1 centimeter distant from the median line and about 4 centimeters distant from the urethral orifice. The bladder was otherwise negative.

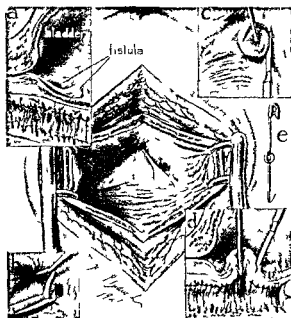


Fig. 1. View showing conditions found within the bladder: the fistula beneath the right ureteral orifice and the band of muscles and mucous membrane which lies over the right ureter to the vesical orifice. This is shown schematically in B from the side. In C the excision of this muscular band is depicted. In D the excision of the fistulous tract with the assistance of traction made by a bent safety pin introduced through the tract into the vagina is shown. In D the same view is shown in section with the use of the special instrument devised for such cases to replace the improvised use of the safety pin.

Because the ureters could not be found or catheters passed up them it was thought unwise to attempt excision of the fistula through the vagina for fear of injuring seriously the right ureter. A suprapubic operation was therefore determined upon and was carried out as follows.

June 9, 1926 the operation by Dr. Young done under gas oxygen and ether consisted of

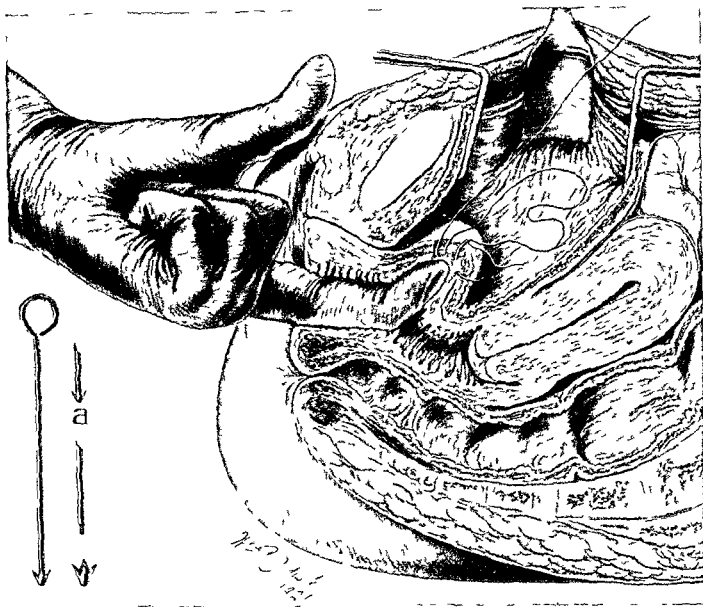


Fig. 2. Sectional view showing the placing of the first layer of sutures in the vaginal submucosa with the assistance of a gloved forefinger in the vagina. In A a simple instrument which carries barbed heads of several different sizes appropriate for fistulae of different diameters is shown. Such an instrument would seem to be more satisfactory than the bent safety pin which was employed. In place of both of these instruments the tractor shown in Figure 4 could be well employed.

suprapubic cystostomy, excision of vesicovaginal fistula from the bladder into the vagina with the assistance of special instruments, resection of vesical bridge, closure of fistula in three layers, the first a purse string of heavy chromic catgut to approximate the vaginal mucous membrane. Much assistance was afforded in placing this suture by the insertion of the finger into the vagina (as shown in Figure 2) and making pressure upon the anterior vaginal wall to elevate the vaginal end of the fistulous tract and to expose the mucous membrane. No difficulty was thus experienced in inserting the needle parallel to the vaginal wall through the submucosa without

penetrating the mucous membrane. About 8 such stitches were placed around the circumference of the vesicovaginal tract, and when the suture was drawn taut, a tight closure was effected (Figure 3a). The second was a purse string suture of plain catgut to approximate the vesical muscle (Figure 3b). The third was a continuous through-and-through plain catgut suture approximating the bladder mucosa, submucosa, and adjacent muscle (Figure 3c). The first two sutures were buried and the last tied within the bladder. The suprapubic wound was drained by a large dePezzer catheter with chromic catgut continuous for the bladder and interrupted sutures of silver



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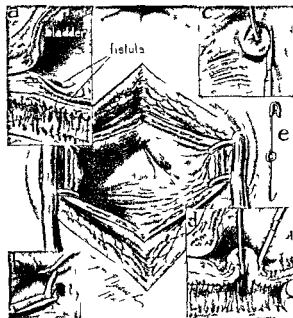


Fig. 1. View showing conditions found within the bladder: the fistula beneath the right ureteral orifice and the band of muscles and mucous membrane which lies over the right ureter to the vesical orifice. This is shown schematically in 1 from the side. In B the excision of this muscular band is depicted. In C the excision of the fistulous tract with the assistance of traction made by a bent safety pin introduced through the tract into the vagina is shown. In D the same view is shown in section with the use of the special instrument devised for such cases to replace the improvised use of the safety pin.

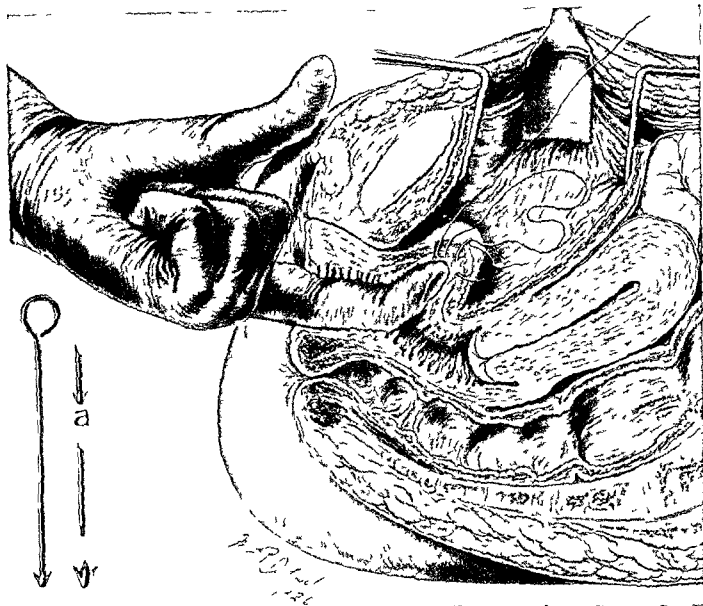


Fig 2 Sectional view showing the placing of the first layer of sutures in the vaginal submucosa with the assistance of a gloved forefinger in the vagina In A, a simple instrument which carries barbed heads of several different sizes appropriate for fistulae of different diameters is shown Such an instrument would seem to be more satisfactory than the bent safety pin which was employed In place of both of these instruments the tractor shown in Figure 4 could be well employed

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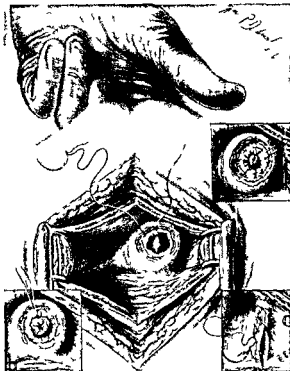


Fig 3 Another view showing the closure of the fistula in the center the placing of the first line of purse string sutures with assistance of a finger in the vagina as depicted. In A this pursestring has been tied and a second purse string through the muscle of the bladder is shown. In B this is seen tied. In C the final closure (intravesical) with chromic gut suture which includes mucous membrane submucosa and some muscle is shown. The bladder is thus closed in three layers of sutures.

wire for skin fascia and recti muscles. I then inserted a small prevesical cigarette drain.

#### DETAILS

The suprapubic scar was excised the bladder opened extraperitoneally in the median line, and the orifice of a small vesicovaginal fistula was disclosed. This was covered by a bridge of tissue which was evidently the right edge of the trigone which had become dissected free and completely covered with epithelium. It formed a bridge which ran immediately across the fistula upward and outward to the right ureteral orifice which was just above the fistulous opening. The left ureteral orifice was found nearer the median line than usual being pulled over by the scar in the right side of the trigone. Both were catheterized and apparently were negative. Before the fistula was attacked the muscular bridge was

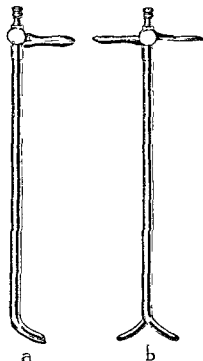


Fig 4 A small tractor similar to Young's prostatic tractor but delicate with solid blades (non fenestrated). This instrument may be employed in fistulae of various characters and locations.

excised, the portion removed being about 1.5 centimeters in length. The fistula lay in a depressed scar and was only 2 or 3 millimeters in diameter. I determined to excise it through the bladder and in order to facilitate this a small hook was made by bending a large safety pin acutely as shown in Figure 1. This was pushed through the fistula and then drawn outward, one side of the fistulous tract being impaled and then drawn upward.

At this point it occurred to the operator that an instrument which has since been designed and illustrated herewith (Figure 1d), would have been of much assistance in a uniform drawing upward and exposing of the fistulous tract. With the edge of the fistula impaled and drawn upward as above described a circular penetrating incision was made with a scalpel around the orifice of the fistula extending from the vesical and mucous membranes through the bladder muscle and vaginal mucous membrane. This incision completely removed the fistulous tract and left a surprisingly large opening because of the retraction of adjacent tissues. Examination showed that scar

tissue was still present in two or three places, and this was excised, further enlarging the wound.

Although it was necessary to operate very close to the right ureteral orifice, it was not injured as it was under constant observation. Had the operation been attempted from the vagina I feel confident that there would have been much danger of injuring the ureter, and it certainly would not have been possible to see its location and thus avoid it.

After excision of the fistulous tract and scar tissue, there presented a fairly large opening, almost 2 centimeters in diameter, in both bladder and vagina. It was determined to close this by means of purse string sutures placed through the bladder. The first layer was through the submucosa of the vagina and did not penetrate the mucous membrane. A purse string suture of heavy chromic catgut was tied through the bladder, thus securing complete closure of the vaginal opening. The next suture was a purse string, but of plain catgut treated with mercurochrome, and approximated the bladder muscle. This left an irregular defect in the vesical mucosa which was closed in a linear direction by means of a through-and-through plain catgut suture, and tied intravesically. The bladder was closed, as above described, around a large dePezzer catheter, and the patient returned to the ward in excellent condition.

She was immediately placed upon her abdomen so as to lie face downward during the early period of convalescence. This plan, which was adopted following the report of Chute,<sup>1</sup> was found a most effective method of keeping the bladder completely empty and thus protecting the vesicovaginal sutures. Although the patient protested somewhat on account of the discomfort of lying on her face, she remained for 10 days in this position with the bladder draining directly downward. On the tenth day she was turned on her back, but the suprapubic drainage was maintained until 3 weeks after the operation when the catheter was removed and the suprapubic wound allowed to heal. She was discharged one month after the operation. There had been no recurrence of the vesicovaginal fistula, the suprapubic wound was solidly healed, and the patient was voiding urine normally through the urethra.

#### COMMENT

A hasty survey of the literature shows that the case described is quite like many reported in the literature, in that they have been subjected to many operations through the vagina before a cure was effected in some cases and in many without closure of the fistula. Not infrequently the ureter was injured or occluded as a result of the vaginal operations. In other cases the vaginal method was quite successful. In view of the remarkable ease with which this operation was carried out in the case outlined, I am tempted to recommend it to other operators.

Some simple instrument inserted through the fistula from above to draw the base of the bladder up to the operator so that he can accurately excise the fistulous tract, is an important addition to the technique and the idea is, as far as I can determine, quite new. The very simple expedient of bending a safety pin so as to make a hook which, when inserted into the fistula, may be used to draw the region of the wound up to the operator was quite satisfactory in our case. The instrument which we have made in our machine shop (Figure 2a) should provide a more efficient method of arriving at the same effect.

We have also constructed an especially thin tractor, similar to our prostatectomy tractor, but with delicate non-fenestrated blades (Figure 4). This is used for fistulae of various types. The instrument is introduced with the blades closed into the fistulous tract, then opened and traction made while the tract is dissected out. Some vesicovaginal fistulae will be found too small for this instrument, but for larger ones it may be employed quite satisfactorily.

What I wish to propose here is the use of traction with the instrument introduced through the fistula to bring the region of the wound nearer to the operator and to furnish counter pressure against which the operation is done, the tractor also to be employed in placing the sutures in the wound. But in my case I used the index finger for this purpose.

In the postoperative treatment, drainage through the suprapubic wound with the patient lying on her abdomen, as suggested and carried out successfully by Chute, is, I believe, very important, and I would recommend that this be used in addition to the intravesical excision with the assistance of traction as carried out in this case.

<sup>1</sup>Chute, Arthur L. A suggestion for the postoperative care of vesicovaginal fistula. *J. Urol.* 1922, 55: 77-81.

## SURGICAL TREATMENT OF RETRODISPLACEMENTS OF THE UTERUS

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THIS study concerns the results obtained in 150 cases of retrodisplacement of the uterus submitted to operation. In order to determine what type of operation may be expected to furnish the highest percentage of relief from the symptoms of uterine retrodisplacement, patients operated upon for this lesion have been examined from 1 to 3 years thereafter. The anatomical and clinical results have been correlated with the special types of operation.

Retrodisplacement of the uterus is a common anatomical finding. Surgeons interested in pelvic operations have long debated to what signs and symptoms this condition gives rise. Some (Mayo) have stated that unless the condition is marked no complaints are caused. The degree of the displacement has thus assumed in the eyes of certain gynecologists a major importance. A mild degree of retrodisplacement of the uterus is present in perhaps a majority of women after childbirth, yet in the nullipara it has been stated to be the cause of sterility.

As early as the latter half of the fifteenth century, Grammateo Ferrari da Grado of Pavia considered the question of sterility due to uterine misplacement and advocated the use of the pessary and truss for prolapse. In 1770 Hunter wrote concerning uterine retroversion and a little more than a century later the operative procedures were devised to which the names of Adams, Alexander Olshausen, Kelly, Baldy, Webster and Gilliam are attached. The multiplicity of the surgical methods for treating this condition is perhaps the best index that either none of the methods is really satisfactory or that there are considerable variations and degrees of the condition—each of which must be helped by a different procedure.

Theilhaber in 1895 first called attention to the occurrence of uncomplicated mobile retroversion without symptoms and Jaschke of Giessen in observations on 1,000 cases of retroflexion retroversion states that pelvic symptoms are as common in women with anteversion as in those with uterine retroposition. Cabot and Bevan hold that operative procedures upon the movable retroposed uterus are unwarranted. The gynecological axiom that retroversion causes sacral backache is denied by Cabot. More recently Findley states that retroversion is only of importance because of

the sterility which is often concomitant. These somewhat nihilistic views however are not in accord with the opinions of other authorities of wide clinical experience. Ward states that simple displacement of the uterus is sufficient mechanical cause for sacral backache, pelvic tenesmus, leucorrhœa and menorrhagia and points out the familiar fact of immediate relief from symptoms often afforded by the insertion of a pessary. The assumption that uterine misplacement very frequently is responsible for symptoms is an *inescapable post hoc propter hoc* since the replacement of the uterus and the application of a properly fitting pessary so often gives immediate benefit. Crossen and Polak believe that retrodisplacement without symptoms is met with very infrequently in actual practice and that local pathological changes or complications due to mechanical pressure or interference with circulation nearly always result. It would appear that there is some doubt concerning the statement that operative suspension for uncomplicated retroversion is "an unwarranted procedure." The very term uncomplicated retrodisplacement in deed is almost a misnomer. Findley reporting in a series of 480 cases only 4 per cent of retroversions unassociated with other pathological changes in the pelvis.

In 1,000 cases reported by Stacey, routine examination revealed retroversion in 20 per cent of patients examined for other than pelvic complaints. Lynch in a careful study of acquired retroversions (459 cases) found the lesion occurring in 41 per cent of women during the first year after labor. These cases were followed 3 years and 51 per cent showed symptoms. Congenital retroversion occurs in 20 per cent of unmarried girls or nulliparous women according to Stacey. In this group usually there is associated genital hypoplasia and deficient muscular and fascial development. Dysmenorrhœa, irregular and scanty periods, backache, leucorrhœa and menorrhagia have a slightly increased incidence in this group (Stacey). The statements that backward displacements of the uterus in single women cause no symptoms and if they are present are due to a neurosis are probably not based upon statistics. There seems no reason to doubt that every acquired retroversion is pathological and produces symptoms or will produce them sooner or later.

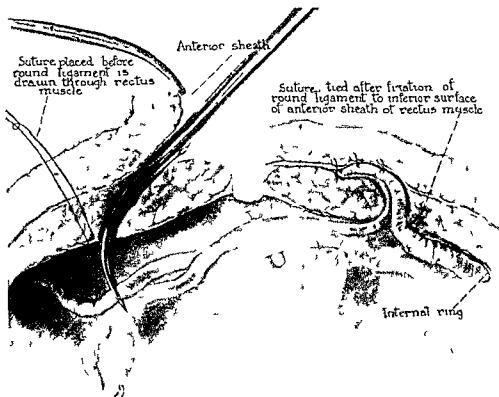


Fig. 1 The modified Gilham procedure

even if uncomplicated. This point is emphasized by the fact that women with mobile backward displacements as the only lesion seek relief in large numbers and are rendered free from symptoms by the replacement of the uterus.

TABLE I—SYMPTOMS UPON ADMITTANCE TO HOSPITAL

	Number of Cases	Per cent
Backache	42	28
Pelvic pain and discomfort	83	55
Habitual abortion	5	3
Leucorrhoea	55	36
Sterility	6	4
Dysmenorrhoea	36	24
Dysuria	15	10
Dyspareunia	9	6
Menorrhagia	1	8

TABLE II—ASSOCIATED LESIONS

	Number of Cases	Per cent
Adnexal diseases	47	30
Relaxed vaginal outlet	42	28
Lacerated cervix	38	26
Ovarian cyst	23	18
Subinvolution	4	3
Ectopic pregnancy	2	6
Ventral hernia	1	3
Chronic appendicitis	12	8

The mechanism which maintains the uterus in normal position consists of (1) the tonicity of its intrinsic musculature, (2) the pelvic diaphragm, and (3) the ligaments of the uterus, excluding the round ligaments which normally play little part in supporting the uterus. Any adequate reparative procedure must owe its success to a clear understanding and utilization of these factors. There is a group of women whose muscles and fascia do not withstand the stretching trauma

TABLE III—RESULTS FOLLOWING THE VARIOUS TYPES OF OPERATION, THE FIGURES REPRESENTING THE NUMBER OF CASES

	Kelly ventro suspension	Baldy Webster	Modified Gilham	The Crossen round ligament transplantation after salpingectomy or salpingo-oophorectomy
Recurrent retro position of the uterus	30	40	40	40
Pelvic pain or discomfort including dysmenorrhea	5	3	0	0
Backache	1	3	1	8
Pregnancy	2	2	1	3
	0	0	4 post partum	1 grand

Ten cases operated upon by the Kelly method were also subjected to bilateral salpingectomy.

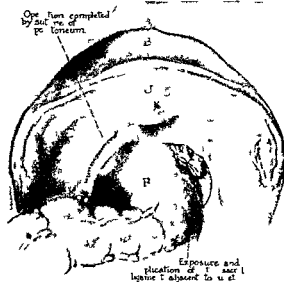


Fig 2 Shortening of the uterosacral ligaments

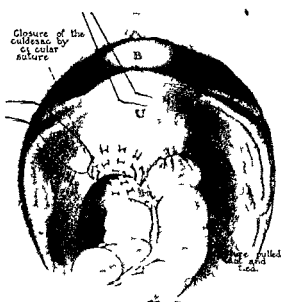


Fig 3 The obliteration of the cul de sac.

incident to labor and who after a single pregnancy show marked diastasis of the rectus muscles retroflexion retroversion of the uterus and relaxation of the perineum

Successful operation must fully overcompensate for this deficiency in natural tone and lack of elasticity of body tissue. This is especially important in the light of the fact that retroposition of the uterus is almost the invariable precursor of prolapse. There is usually an associated descensus with retrodisplacements. Thus operative replacement of the uterus which does not take cognizance of the descensus is liable to failure.

In an analysis of 150 cases of retrodisplacement of the uterus the condition was found to exist in the absence of complicating pathological change in only 10 per cent. The remaining 90 per cent (136 cases) were admitted with the symptoms and associated lesions shown in Tables I and II.

In this series of cases it is evident that the symptomatology is that of the complications and that the retroversion itself is often a result of the associated lesions.

**Operative treatment.** The number of different procedures used indicates the obvious fact that many surgical methods are employed by various operators. The following procedures were carried out (Table III): (1) the Kelly ventrosus pention (employing the vesical peritoneum) (2) the Baldy Webster method (3) the Crossen technique (posterior folding of round ligaments

over the pedicle after salpingectomy or salpingo-oophorectomy) (4) the modified Gilliam operation.

A perineorrhaphy was performed to maintain the posterior position of the cervix wherever there was diastasis of levator muscles.

**Classification of the conditions for which operation was performed.** Group A Those cases in which the pelvic organs are freely movable and the adnexa free from inflammatory disease including cases of marked descensus in which the cervix does not present at the introitus of the vagina. Group B Those cases with adnexal disease requiring unilateral or bilateral salpingectomy or salpingo-oophorectomy.

The results of the modified Gilliam technique of suspension proved in this series to be satisfactory both in the light of the anatomical and clinical results and the important feature of pregnancy. Discounting the factors of previous fertility and of contraception the occurrence of pregnancy in 17 per cent of suspensions by this technique seemed worthy of note. No abortions or pregnancies were reported in any of the other cases not subjected to salpingectomy. A satisfactory anatomical result was found on pelvic examination without exception in the cases operated upon by the Gilliam procedure which proved to be sufficient support with the addition of a perineorrhaphy even in cases with marked descensus. In a number of these cases an additional support by means of shortening the utero

sacral ligaments might well have been performed. Crossen is of the opinion that perineorrhaphy usually suffices to maintain the posterior position of the cervix and advocates sacral suspension as the best procedure for prolapse in the child bearing period.

Failure to attain a proper anatomical result with the ventrosuspension in 5 cases might have been expected. A strand of peritoneum is too frail to be dependable as a means of modifying the position of a solid muscular organ.

The Baldy-Webster technique of suspension is open to the objections of the utilization of the weak portion of the ligament with a doubtful point of lateral attachment, that is beyond the internal inguinal ring. There also may occur thrombosis or injury to the veins of the broad ligament. There were unfortunately, 3 cases of acute retroflexion following the Baldy Webster suspension in our small series.

Round ligament folding over the pedicle after salpingectomy or salpingo oophorectomy as employed by Crossen is an excellent procedure both from a clinical and anatomical view point. The worst cases of pelvic inflammatory disease received this form of suspension. The persistence of pelvic complaints of various grades in these cases does not reflect discredit upon the operation since a severe grade of adhesion formation was inevitable. Suture of the round ligaments by the Kime technique was occasionally utilized in this series. The relative escape from adhesions afforded through peritonization of raw surfaces by these procedures, has not been sufficiently emphasized.

#### THE TECHNIQUE OF THE MODIFIED GILLIAM OPERATION

Speed and ease are essential in the performing of the suspension operation because gynecological operations are likely to be multiple procedures. We feel that the operation described below fulfills all the requirements in cases with intact adnexa and mild descensus.

The fascia is elevated from the anterior surface of the rectus muscle at a point approximately 1 inch above the symphysis, and the rectus muscle is pierced with a Kelly or Crossen clamp approximately 1 5 inches from the midline, avoiding the bladder. The peritoneum may be pierced slightly lateral to the point of emergence of tip of the clamp from the muscles. This makes avoidance of the urinary bladder more certain and does not affect the point of suspension. The round ligament is grasped at a point 1 5 to 2 inches from its cornual insertion, and the clamp's tip turned

toward the incision. This gives easy access to the space between the point of perforation of the clamp and the internal inguinal ring. A circular suture placed in the peritoneum and the distal portion of the round ligament insures the closure of this area and removes its danger as a potential hernial sac. This is much more easily accomplished at this point than after the ligament has been drawn through the muscle. The ends of this suture are laid aside without tying (Fig 1). The round ligament is now drawn through the rectus muscle to the under surface of the rectus sheath, the amount of tension necessary to support the uterus in proper position determining the length of doubled ligament which is drawn through the perforation. The round ligament is sutured to the fascia on its inferior surface with three silk sutures. Suture to the under surface of the fascia avoids the tender points of which patients occasionally complain. The circular suture previously placed is now tied and then the enclosed area is tested by attempting to insert a finger between the portion of the round ligament lateral to the point of perforation and the internal inguinal ring. These steps are best carried out alternately on the two sides. The method is easy, rapid and effective, utilizing as it does medial points of support and bringing only the strongest portion of the round ligaments into play. The fact that the round ligaments undergo hypertrophy, as does the uterus, gives the method the greatest promise of effectively withstanding pregnancy without increasing markedly the danger of abortion.

#### FURTHER PROCEDURES WHERE DESCENSUS IS MARKED

In marked relaxation of the uterosacral ligaments with descensus of the uterus the subperitoneal shortening of the uterosacral ligaments as advocated by Young is of advantage. This may be rapidly performed if exposure is adequate. The uterus is pulled strongly up and toward the symphysis pubis throwing the uterosacral ligaments into relief. The peritoneum is incised from a point 5 inch from the cervical attachment of the ligament and extending posteriorly over it. The ligament if well developed is easily isolated and a simple doubling plication performed with two sutures reinforcing with additional interrupted sutures (Fig 2). The position of the ureter must be kept constantly in mind. Experiments on the cadaver, with this procedure, show how easily the ureter may be injured. Closure of the peritoneum over the shortened ligament with a fine continuous suture completes the operation.



When the patient is beyond the child bearing period with high rectocele and retroversion and descensus of the uterus the Moschowitz procedure of closure of the cul de sac may be combined with a round ligament suspension by the technique previously mentioned. This procedure properly performed should be almost certain of cure in cases of potential prolapse. Homans states that successful pregnancy may follow even when the closure of the cul de sac and a Gilliam suspension have been performed. Good exposure is essential. The fundus (Fig 3) is pulled forward strongly and the sigmoid is put on stretch, spiral or interrupted circular sutures of silk are placed incorporating the vaginal wall, pelvic fascia and the sides of the rectum to a point 1 inch above the lowest point of the cervix uteri (Homans). This procedure has proved satisfactory in a small series of cases. The choice of operative procedures and its adaption to the anatomical need of the individual patient is a matter which should receive the most careful consideration.

#### CONCLUSIONS

1. Acquired retroversion or retroflexion is pathological and should be treated surgically if investigation indicates its responsibility for the symptoms.

2. Our experience in this clinic indicates that round ligament suspension of the Gilliam type is the most satisfactory means of surgical cure of retrodisplacement of the uterus in cases with intact adnexa.

3. Shortening of the uterosacral ligaments and the Moschowitz closure of the cul de sac are effective procedures in cases of retrodisplacement of the uterus with marked descensus.

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## INDICATION FOR OPERATION IN PUERPERAL PELVIC THROMBOPHLEBITIS

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WHEN in 1917 I presented my lecture on "Septic Puerperal Uteropelvic Thrombophlebitis" before the Argentine Society of Obstetrics and Gynecology, I was not a little surprised to find that among all the distinguished gynecologists present not one had seen a case of ligation of the veins and many of them considered the clinical entity of thrombophlebitis questionable.

Ten years have passed since that time and doubtless today a similar work would attract less attention than that did. But not very much has been written on the subject yet and since the compilation of Miller, in 1918, I have not seen in the bibliography which I have available any work capable of settling the doubts which I entertained at that time and which still persist.

This article, which is based on two cases of thrombophlebitis observed in my clinical service, taken at random from many others, has for its object the stimulating of my colleagues to report their cases to the society to see whether it is possible to determine exactly the conditions under which operation, ligation or excision of the thrombosed veins, is indicated. The two cases to which I refer are as follows:

CASE 1. Second Obstetrical Clinic Case No. 15153/28980. Consuelo E de V. XI para age 34 years admitted January 1, 1926 at 10 o'clock. She had been delivered 2 hours before at home and was sent to the hospital because the placenta had not been delivered. Dr. Cauzain found that the placenta was completely and strongly adherent and practiced artificial extraction. The patient lost a great deal of blood. An ice bag was applied to her abdomen and pituitrin given subcutaneously. Beginning on the fourth day the lochia was fetid and the patient's temperature began to rise. On the sixth day she had a chill and a few hours afterward (January 7) another from 25 to 30 minutes in duration with temperatures of 39.3 and 39.6 degrees. Three hours after the second chill she had another with a temperature of 41 degrees, pulse 180, she was in a serious condition of collapse. On January 8 she had another chill which lasted 20 minutes and on the 9th a fifth. Uterotropin was given intravenously. Examination of the blood at this time showed erythrocytes 2,500,000, hæmoglobin 60 per cent, leucocytes 21,800 (polynuclears 79 per cent, lymphocytes 17 per cent, large mononuclears 2 per cent, eosinophils 2 per cent, blood culture negative). The chills were repeated on the 12th, 13th and 15th and on the 15th day signs of small suppurative embolism developed. On the 16th for the first time thrombosed veins could be felt in the broad ligaments. On the 18th a slight chill and a temperature of 39.8 degrees were noted. On that day examination of the blood showed erythrocytes 3,950,000, hæmoglobin 70 per cent,

leucocytes 15,600 with a formula similar to that of the first examination. On January 19 salvarsan was begun intravenously and the previous treatment continued. A fixation abscess was produced. On January 21 there were the same signs of thrombophlebitis as on the 16th. The fixation abscess gave a positive reaction. Between the 10th and 21st her general condition was so bad that it was not thought advisable to run the risk of laparotomy or to ligate the veins. Neosalvarsan and uterotropin were administered intravenously. On the 26th the patient was very evidently better, her temperature had fallen to less than 37 degrees and her pulse to 80-84. However examination still showed a packet of thrombosed veins. From this day the improvement continued rapidly and the patient was discharged February 7. When she was examined a month later nothing abnormal was found in the genital tract.

CASE 2. 2d Obstetrical Clinic case No. 15196/29079. Maria M de M. I para age 0 years entered January 9, 1926 after having had a spontaneous delivery at home on January 3. It required several hours manipulation to bring about the expulsion of the placenta. On admission her general condition was moderate, temperature 39 degrees, pulse 112. There were perineal and cervical tears covered with false membranes, lochia was purulent. In the right lateral cul de sac there was a slight infiltration of the broad ligament. The usual treatment was given. Examination of the blood on the 11th showed 2,750,000 erythrocytes, leucocytes 11,800 (classification normal), hæmoglobin 70 per cent, blood culture negative. On the 12th she had a chill, temperature 40.4 degrees. On the 13th injections of septicæmicea were begun. On the 15th and 16th the chills were repeated (40-41.8 degrees). Her temperature remained high. Examination on the 16th showed that the parametrial infiltration had disappeared but there were thrombosed veins on both sides. Her general condition contra indicated any radical operation. On the 19th a fixation abscess was produced. The septicæmicea was continued. On the 21st the signs of thrombophlebitis were even more evident, the fixation abscess was positive. Neosalvarsan was begun intravenously. There was œdema of the right arm. On the 22d improvement began and was only interrupted on the 30th by a rise of temperature to 39 degrees. The intravenous injection of salvarsan was continued. On the 6th the thrombosis on the left side had disappeared but that on the right continued. She was discharged on February 8 and no further news has been received of her.

On principle, in view of the great gravity of the thrombophlebitic forms of puerperal infection—perhaps less, however, than is classically believed—there is a tolerably general consensus of opinion that ligation, and exceptionally and with great caution, excision, of the thrombosed veins is permissible. As it is only in serious cases that the problem of operation arises and as the mortality in these cases is more than 85 per cent and in some hospitals as high as 100 per cent, any treatment capable of lowering this appalling figure is worth

trying Surgical operation gives an average of 35 per cent recoveries. I myself have ligated the veins in 3 cases the first patient recovered the second died the night of the operation with symptoms of pulmonary embolism (autopsy was refused) and in the third the disease continued to progress and autopsy showed subacute adhesive purulent peritonitis my percentage (33 per cent) is about the same as the average.

The technique which is very well known is not difficult. But doubt and discussion arises when it comes to determining the best time to operate. Tuffier thinks he has settled the question very cleverly with a phrase. To operate very early is a crime and to operate very late is useless. Trendelenburg recommends operating immediately after the first chill Bondy Schottmueller and Beuttner after three chills and the demonstration of streptococci in the blood. Williams and Bardeleben wait for the appearance of palpable veins. Miller in 103 cases in which the time of operation was given found the following

Operation	Cases	Per Cent	Deaths	Per Cent
First week	9	69.3	4	50
Second week	12	44.4	15	50.6
Third week	10	50	10	0
Fourth week	8	40	1	60
Fifth week	4	4.5	3	5
Sixth week	3	42.9	4	5.1
Seventh week		40	3	60

Bumm is opposed to operation during the acute stage of the disease which he gives as from the tenth to the fifteenth day because he thinks that the friability of the clot renders the operation dangerous or useless and he also thinks that it is useless to operate when there are other lesions. These reasons of Bumm's lead me to take up the question of when operation ought not to be performed. In my work in 1917 I gave two important contra indications (1) when there is persistent bacteremia and confirmed septicoemia (2) when there are predominant uterine and juxta uterine lesions. To which I would add (3) when the general condition of the patient and rapid progress of the symptoms (chills hyperthermia or coldness icterus) show that it is a rapidly fatal form of the disease and (4) in ascending forms of thrombophlebitis.

Vanvert and Paucot in their memoir in 1913 say that in early forms and forms with multiple metastases it is at least useless to operate. Leopold thinks that in the rapid forms it is impossible to operate early enough. As can be seen the contra indications are definitely enough established to leave no doubt. To return to the most interesting point Sanes of Pittsburgh in 1913

said that in his opinion the operation was indicated (1) when thrombophlebitis was diagnosed before chills began (2) in chronic forms when there are no complications and the general condition is good before the chills (3) as a last resort in acute cases with rapid progress (4) in acute cases with palpable veins and good general condition, even after several chills if the case is apparently growing worse (5) in acute cases without palpable veins but with the clinical signs of thrombophlebitis.

Vanvert and Paucot, in their memoir in 1913 say The course and duration alone give insufficient information. Operation is indicated when in the course of a chronic thrombophlebitis, after a remission there are renewed symptoms—fever chills and signs of embolism. But they add Under these circumstances successful operations have been performed but it must be admitted that similar cases may recover without surgical operation. This shows the variations in the most authoritative opinion up to the present time.

#### FACTORS INFLUENCING TIME OF OPERATION

Let us see if it is possible to draw any more definite conclusions from the facts observed and for this purpose let us study separately the elements which these authors have made use of in determining the time for operation.

*Etiological data.* It is evident that labors that are difficult prolonged the patient being septic before delivery labors that are accompanied by traumatizing or atypical manipulations, labors that have been preceded or accompanied by hemorrhage labors in women who live in poor social and hygienic conditions or who are toxicemic and induced abortions favor infection and so make a localization of it in the veins possible. But how many exceptions there are to the rule, how many infractions of the laws of correct technique and strict asepsis without such results. Nothing in the etiology therefore would tend to lead us to operate.

*Bacteriology of the infections.* It is well known that the bacteriological findings give little help in determining treatment. In view of the frequency of recovery when streptococci are very evidently present and even when blood culture has been temporarily positive it is not possible to base an indication for operation on the positive finding of these bacteria. And the finding of a hemolytic power in certain types of streptococci prevents action as the patients infected with these strains only rarely escape death and some of them die so quickly (3 to 4 days) that it is not even possible to make an exact diagnosis.

*Chills* It is surprising to see some eminent clinicians base indications for operation on an arithmetical formula. It is impossible to base a decision either on the number or duration of the chills or the figure to which the thermometer rises. The first of our two patients had 8 chills and the second 3. The temperature went to 41 degrees in the first case and the pulse to 180 and in the second to 41.8 degrees and we have seen patients recover after 10, 15, and 20 chills and temperature over 39 degrees for days.

*Embolism* Visceral embolism, particularly pulmonary, has been regarded for many years as an index of a thrombophlebotic process. Our first patient had a subpleural embolism and among the many cases observed in our service this accident has generally coincided with thrombosis of the veins of the lower limbs or preceded it a little. At this moment we have in the hospital a woman with a serious infection, with bilateral phlegmasia alba dolens, periphlebotic abscesses and presumably a pelvic thrombophlebitis of which we cannot be certain, because we have not dared move her to examine her pelvis, she has had an extremely grave infection with blood culture positive for streptococci several times and yet she seems to be overcoming the infection (her blood culture is now negative) after having been treated with large doses of autovaccines and antistreptococcal serum. This patient very probably had a pulmonary embolism which did not make any fundamental change in her condition.

*General condition* In pelvic thrombophlebitis the general condition may remain good for a long time, contrasting with the repeated chills and the high temperature. This paradoxical euphoria of these women who are irrevocably condemned is very tragic. And this persistence of a relative organic equilibrium is the reason for many operations, since it is in cases of this kind that the obstetrician, powerless in his treatment, risks operation. But the boundary line between the condition of resistance and that which precedes final defeat is so indefinite that it is not possible to determine the really favorable moment for operation. In our two patients the general condition was serious for several days just at the time when an operation would have been most useful, but this did not prevent their recovering. We have seen patients in this serious condition recover and others die. The reason for this victory over the infection is not known, for in view of the inconsistency of the results of all treatments (serums, vaccines, salvarsan, urotropin, hæmoclastic crisis, etc.) and the even more frequent failures of all of

them, no positive value can for the present be imputed to any of them.

*Results of fixation abscess* I will not enter into the debate that has been begun in France in regard to the value of fixation abscess. I will not go so far as to say that it cures infection but I think there is no question as to its value as a sign in prognosis. It is the current opinion in our service that when the abscess is frankly positive the patient will not die. Therefore, this is a factor which favors operation. But then have we not seen many patients recover spontaneously when the abscess was positive?

*Exact diagnosis of the lesion* While it is true that a direct diagnosis of the vein lesion can often be made, the probable diagnosis of thrombophlebitis is often made from the clinical course, from the great oscillations in the fever curve and from the chills.

Our two patients prove that cure is possible even with very evident clinical signs. It must not be forgotten that sometimes thrombosed veins can be palpated in cases in which the clinical course does not show the typical fever curve. It is very possible that these cases are ones of aseptic puerperal thrombosis and their presence, as is shown by the course, has no pathological significance.

*Value of the factors in deciding on operation* The picture drawn by Miller is not very convincing. Operations in the first week give 69.3 per cent recoveries, those in the fifth 74.5 per cent, and in the other weeks the percentage varies from 40 to 50 per cent. How many surgeons would dare to operate in the first week when the symptoms are barely beginning if they were accustomed, as we are, to seeing them change for the better spontaneously in the course of the second? And does not the high percentage of recoveries in the fifth week coincide with the time when the organism itself is gaining the victory?

As can be seen, the balance reached is not very instructive. Though convinced of the usefulness of ligation of the veins in serious cases in spite of the objections and restrictions imposed on it by many experts, I do not feel justified at present in establishing formal rules for deciding on the time for operation. It is not pleasant to confess it but in my judgment, what Vanvert and Paucot said before the Obstetrical Society of France is true now as it was in 1912: "It is impossible to give exact indications for surgical operation, both operation and abstention are justifiable. The surrounding conditions and the temperament of the surgeon will be of great importance in making the decision."

# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.  
ALLEN B. KANAVEL, M.D.

Managing Editor  
Associate Editor

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Chief of Editorial Staff

AUGUST 1927

### REDUCING POSTOPERATIVE PULMONARY EMBOLISM

**M**ANIFOLD physiological changes follow surgical operation. The tendency toward a decrease in the rate of blood flow following operation was described as early as 1846 by Virchow. To overcome this tendency postoperative exercises have been suggested by Wilson and Pool and early movement of the patient in bed has been recommended by Coffey. Unfortunately neither procedure has been carried out sufficiently to determine its effect. Both active and passive movements of the extremities should tend to increase the rate of blood flow in the largest branches of the inferior vena cava. In a series of studies by Walters, Hendricks, and Greene on blood pressure and chemical changes in the blood of 25 patients it was shown that while they were resting in bed after operation there was an average daily drop in systolic and diastolic blood pressure of 4 millimeters of mercury with an average total drop of 30 millimeters. A noticeable increase in the fibrinogen of the blood and in most instances an increase in leucocytes were the outstanding blood changes

Extending this idea further it would seem that depression of the rate of metabolism during this period of enforced rest in bed is of prime importance and that as a result of it not only the circulation of blood but the function of all the organs of the body becomes sluggish. Furthermore it is a reasonable hypothesis that during the period of intestinal quiet which invariably follows abdominal operations the flow of blood in the branches of the mesenteric arteries and veins is diminished because of the loss of the pumping effect of peristalsis that this produces stagnation in the portal system and that although the liver acts as an intermediary organ between it and the general circulation a corresponding effect may be produced on vascular flow in general. A sudden increase in intra abdominal pressure such as that caused by a sneeze or a cough is so painful that the patient takes every precaution to prevent its recurrence and although he may not be aware of it the depth of breathing is restricted so that it becomes thoracic in type with consequent diminution in diaphragmatic excursion and the effect of the to-and-fro normal respiratory movement on the viscera and the blood vessels is decreased.

In order to combat the depression of metabolism the decrease in blood pressure and the slowing of circulation tablets of desiccated thyroid in 2 grain doses administered 3 times daily has been used in a series of personal cases in which operation was performed during the last 2½ years. It is given as soon after operation as the gastrointestinal tract tolerates fluids and medicine without difficulty, usually the third or fourth day and is

continued until the patient is out of bed. If elevation of pulse rate and temperature occur to too marked a degree it is discontinued. Inasmuch as this denotes an increasing rate of metabolism, which is the primary object of the treatment, it cannot be considered a deleterious effect. No other untoward effects have been noted. In addition, patients have been urged to move in bed, especially to turn from side to side. The group to date comprises over 2,000 personal cases in which major operations were performed. No patient died from pulmonary embolism. In the cases of 2 seriously ill patients, both more than 70 years old, with marked cardiovascular renal disease, who died from other causes, pulmonary embolism was a coincidental and unexpected finding at necropsy. It would seem that these 2 cases are examples of that small proportion in which, in the presence of marked cardiovascular disease in elderly patients, embolism may occur as a terminal event similar to bronchopneumonia. The method herein described would seem to have its greatest field of application in the cases in which, there being no gross cardiovascular disease, fatal pulmonary embolism is such a catastrophe.

Further clinical support of the value of increased metabolism in the prevention of thrombosis and embolism is lent by Plummer's observation that in cases of severe cardiac decompensation coincident to hyperfunctioning thyroids, thrombosis and embolism practically never occur. Experimental evidence in support of the hypothesis is seen in the recent work of Shionoya and Rowntree with the use of the extracorporeal vascular loop *in vivo*. In studying the circulation in rabbits they noted that thrombosis in the loop occurred normally in from 4 to 10 minutes. When 1 milligram of thyroxin was administered daily for 3 days to each rabbit, throm-

bosis in the loop did not occur for 25 to 30 minutes, the change was sustained for 3 days.

Undoubtedly there are factors other than slowing of the rate of metabolism, lowering of blood pressure, and possible retardation of the circulation that are responsible for the formation of thrombi and emboli, else the incidence of postoperative embolism would be much higher. It seems reasonable, however, that they set the stage, and whether infection as may be inferred from Rosenow's isolation of streptococci from emboli at necropsy, or changes in blood fibrin, or unknown changes in the blood or tissue fluids, are the factors, is as yet undetermined. However, lowering of blood pressure, depression of metabolism, and possibly slowing of the circulation as a result of prolonged rest in bed with great diminution of peristalsis and the restricted excursion of the diaphragm following operation play an important part in either the predisposition to, or the causation of, postoperative thrombosis and embolism. Attempts have been made to overcome these changes by increasing the metabolic rate, using tablets of desiccated thyroid gland. WALTER M. WALTERS, M.D.

## URETERAL STRICTURE

**F**EW subjects have attracted more attention during the past few years than that of ureteral stricture.

Hunner and his supporters maintain that ureteral strictures are constantly overlooked and that the condition is an exceedingly common one. They are finding them at all ages and in both sexes, on both sides and at many different levels in the same ureter. Their recognition according to this school, if one is permitted to employ such a term, explains many symptoms which have been erroneously attributed to other lesions.

The examination consists essentially in the

passage of ureteral bougies or catheters equipped with bulbs of varying calibre. Upon withdrawal of the bulb one encounters a resistance or "hang" at each point of constriction. Even the transitory dilatation incident to the passage of such bulbous bougies suffices to dilate the strictures and is followed by complete cessation of symptoms. Hunner, whose practice is chiefly confined to women, employs the Kelly type of cystoscope and after introduction of the catheter into the ureter removes the cystoscope and depends on observation of the length of catheter which has been withdrawn to determine the level or levels of narrowing. In the male the bladder is filled with water instead of air so that the level of narrowing can be observed visually. The degree of stricture is of course measured by the use of bulbs of varying calibre. In many instances these findings are confirmed by ureterograms. Many are so examined without the complete withdrawal of the catheter.

The opponents base their argument first upon the fact that such narrowings are rarely found at autopsy. Second they claim that except when the examination is made under the control of the eye with the ureteral orifice in view it is very unreliable. Because there are so many normal points of narrowing, especially in the pelvis portion and at the vesical orifice itself, one can be easily deceived as to the so called "hang." Third they say that unless ureterograms are made with the catheter completely withdrawn, areas of apparent narrowing are of no significance. Fourth the relief of symptoms cannot be explained by such a transitory dilatation and is in all probability due to the influence of the various antiseptics which are instilled following the passage of the bulbous bougies. Finally they believe that a study of the ureter should be made during life in a relatively large number of cases (of all ages and both sexes) in which

no genito urinary lesions appear. They feel certain that the same "hang" and narrowings will be obtained in the ureterograms at many places which now are interpreted by Hunner and his followers as strictured areas.

Having heard both sides, let us sum up the evidence. Hunner deserves great credit for his pioneer work and courageous defense of his conception of the subject. Autopsy reports are accumulating to support his theory. In many hitherto undiagnosed cases the patients have been helped because of our more exact methods in which the bulbous ureteral bougie and the ureterogram have played the leading part. On the other hand the point made by Hunner's opponents that his own methods of examination are likely to lead one astray in the elimination of normal points of narrowing in the ureter and especially at the ureteral orifice is not without justification. The same is true of their contention that such transitory dilatations can hardly contribute much to the absorption of cicatricial tissue at the point of stricture. If ureterograms are made repeatedly (on both sides either simultaneously or at different sittings) and one can eliminate ureteral spasm and normal points of narrowing and yet the ureterogram continues to show a sudden definite constriction with marked dilatation above, no fair minded individual can deny the existence of a stricture. If furthermore the examination of this area with bulbous bougies is constantly controlled visually with the ureteral orifice in view and the distance at which the obstruction was met observed by markings on the catheters, the objections of the opponents can no longer be considered valid.

One must grant that ureteral strictures are a clinical as well as pathological entity but the interests of surgical progress demand that rigid tests should be applied in their diagnosis.

DANIEL N. EISENDRATH, A. B. M. D.







*John G. Clark*

# MEMOIRS

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JOHN GOODRICH CLARK

1867-1927

JOHN GOODRICH CLARK was born in Wayne County, Indiana, June 4, 1867, the son of Nannie and Thomas E. Clark.

He came from Quaker stock and was educated in public schools until 14 years of age and then entered the preparatory department of Earlham College, Richmond, Indiana, where he remained 2 years. He matriculated in the Ohio Western University and became a member of the Beta Theta Pi Fraternity. At the completion of his sophomore year, he joined a U. S. civil engineering party detailed for the survey of the Nez Perce Indian Reservation in Northern Idaho. He later joined a party occupied in the survey of the Utah and Northern Railroad, holding the position of topographer and subsequently that of levelman. At the completion of this survey, he entered the school of medicine at the University of Pennsylvania and was graduated in the honor list in 1891.

Dr. Clark served as resident in the St. Agnes and Children's Hospitals of Philadelphia and in the surgical wards of the Bellevue Hospital, New York, and then entered the gynecological department of the Johns Hopkins Hospital, under the directorship of Dr. Howard A. Kelly. He served first as anesthetist, next as assistant resident physician, and completed his service as resident gynecologist in the Johns Hopkins Hospital, after which he received the appointment of associate in gynecology in the Johns Hopkins University.

In 1898, Dr. Clark entered the anatomical laboratory of the University of Leipzig as a special student and began research work under Professors His and Spalteholz on the life history of the corpus luteum and at the completion of this investigation, he went to Prague and published two additional papers upon research from Prof. Charri's pathological laboratory. Upon his return to the United States in 1900, he was elected professor of gynecology in the University of Pennsylvania and gynecologist in chief to the University Hospital. He subsequently became consultant gynecologist to the Woman's College, Bryn Mawr, Germantown, Chestnut Hill, and other hospitals.

As a surgeon, Dr. Clark had few equals, his delicacy of touch, knowledge of anatomy, and dexterity, were unsurpassed. His diagnostic ability was almost uncanny and this, backed by his large experience and personal charm, account

largely for his great success in practice. An outstanding feature in his work was his personal interest in his patients. The real welfare of each person coming under his care invariably took precedence of everything else. No patient however poor but upon whom he would willingly expend as much time and effort as upon the most important. This attitude doubtless accounted for the universal respect and love borne him by his patients.

Dr. Clark was not only a great surgeon but also a scientist in the best sense of this much abused term and nothing interested him more than sound research work. He was a man of fertile imagination and could always suggest practical methods of attacking a difficult problem. His reasoning was sound and his deductions singularly free from error. He contributed largely to the literature of his specialty and was one of the first to advocate a radical operation for cancer of the cervix. In developing this operation he was influenced by the improved results which had been secured by the Halsted operation for cancer of the breast. Despite the many calls upon his time incident to his teaching and large private practice he averaged two major papers a year for the last two decades. Although frequently urged to do so he steadfastly refused to write a textbook not so much because of the drudgery entailed as that the work necessarily was largely a repetition of what had previously been written and also due to the fact that he felt that there were already so many excellent books available. In 1909 he edited the American edition of Winter and Ruge's *Gynecological Diagnosis* and later consented to collaborate with the writer in the monograph on *Radium in Gynecology*. He was one of the pioneers in the employment of radium for gynecological lesion and was an accepted authority upon this subject.

Dr. Clark was a teacher of unsurpassed ability and possessed the happy faculty of imparting knowledge easily and in an unforgettable manner. His mind was a storehouse not only of scientific facts but of epigrams and anecdotes which were always appropriate and enabled him to emphasize the points which he wished to stress. As a result his teaching was always interesting and never dragged. He was not a believer in the ordinary didactic lecture. He was one of the first if not the first to utilize plastine or artist's clay for demonstrating operative technique and as a modeler and blackboard artist he had few equals.

During the World War Dr. Clark was a member of the National Defense Council to which he gave unreservedly his time and energy. He was a member of numerous medical societies and a past president of the American Gynecological Society, American Gynecological Club and American College of Surgeons of which organization he was one of the founders and a member of the Board of Regents since 1924. For years he served upon the editorial staff of its official journal.

To his assistants Dr. Clark was the ideal Chief generous, kindly, helpful and stimulating. His advice was invariably excellent and was always at the disposal

of his associates. He was a believer in the value of travel and had visited practically all the important gynecological and surgical clinics of the world. In 1921 he visited China as a member of the distinguished Rockefeller Commission for the opening and the dedicating of the Union Medical College of Peking.

He was endowed with an extremely retentive memory and rarely forgot a face, a name or a fact. He was a student of American history and had intended writing a book dealing with certain phases of pioneer days. Beyond reading and history his chief recreation was golf, of which he was extremely fond. By his death the world has lost a surgeon, teacher and scientist of unsurpassed ability, and those who were privileged to have been his intimates have lost an unreplaceable friend.

CHARLES C. NORRIS

# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

By ALFRED BROWN M.D. F.A.C.S. OMAHA

### THE TWELVE BOOKS OF MEDICINE ALEXANDER OF TRALLES

THE founding of the Eastern Capital of the Roman Empire at Byzantium marked the beginning of the shift of the center of world activity from Italy and Greece to Asia Minor. A few centuries later the fall of Rome plunged the world into the so-called Middle or Dark Ages during which world domination shifted from Christian Europe to Mohammedan Orient. At the beginning of the period Asia Minor still held what little was left of Grecian art and culture and much of the world's wealth. Of the countries of Asia Minor Lydia was probably the richest and brings to mind at once its king Croesus reputed to be the richest man in the world. It was in this country at Tralles that Alexander was born toward the close of the sixth century. He was reputed to be the son of a physician Stephen of Edessa who served for a time at the court at Byzantium. He learned medicine from his father and from a tutor and patron the father of Cosmas possibly related to Cosmas Indicopleustus to whom we owe so much for his history of the Indian Syrian Christians of the Nestorian type who were driven out of Asia Minor. He was not satisfied to remain in Lydia but after receiving as much as he could from his father and tutor began to travel going to Spain Gaul Africa and Italy possibly as a military surgeon. He gained a great reputation as a physician and teacher finally being offered a position of importance at Rome which he accepted and there spent the remainder of his life.

Alexander's principal work the twelve books of medicine which was to hand down the traditions of Hippocrates and Galen to future generations through the intermediation of the Arabians was written originally in Greek even though the author was living in Rome. It was soon translated into Latin and Arabic and became an authoritative work. It was first printed in 1504 and subsequently often reprinted both in Greek and Latin. One of the best translations is supposed to be that of Guinter of Andernach a famous medical linguist of the sixteenth century. It was printed at Venice by Jerome Scotus and appeared in 1555 (see illustration). The volume also contains a translation of Rhazes work on The Pestilence. The two works are said to be now for the first time most accurately translated from the Greek and restored and corrected in many places by John Guinter of Andernach. The book

is an example of the period when the medical renaissance was under way and was published as were so many of the works of the ancient authors in an attempt to stay the rise of the then modern medical authors and keep medical thought and teaching subservient to the dicta of the ancients. It was published apparently as a textbook to be used by the students in the universities and as the language of medicine was Latin it was printed in that tongue. The original which Guinter says he followed closely after he had decided what the original was lent itself excellently to this use for the work is above everything else didactic in its make up. It seems to bear witness to the fact that Alexander was a teacher for no one but a teacher could have or would have arranged the material in such form as it appears here. He covers the diseases of the body from head to heels taking them up in short paragraphs giving most lucid descriptions and stating his points clearly and concisely. The first book begins with Alopecia and the last ends with a discussion of intestinal hepatic and pulmonary fevers taken from the work of Aetius of Amida. Alexander seems to have been well acquainted with the literature of his predecessors though he does not follow them blindly as did most of the men of his time. There is practically no operative surgery in the book and the treatment for most of the surgical diseases noted is medical of course considering blood letting which he advises frequently, as medical treatment. The book however gives a good idea of the amount of surgical diagnosis known in the sixth century. The author distinguishes between inflammation of the lung and that of the pleura and states that if pus is free in the chest it can sometimes be heard to splash when the patient is moved suddenly. In his discussion of stones in the urinary tract he is rather disappointing as he does not mention operative treatment though he differentiates between stone in the kidney and stone in the bladder. In another chapter he also draws a distinction between obstruction of the bowel due to mechanical means and that due to inflammation. Correctly he advises against the use of cathartics in the latter.

After looking over the work one almost comes to the conclusion that the book was written primarily as a textbook for a course in diagnosis and that the therapeutic side was purposely restricted to medical measures.

# ALEXANDRI TRALLIANI MEDICI

ABSOLVTISSIMI  
LIBRI DVODECIM  
RAZÆ DE PESTILENTIA

Libellus Omnes nunc primum de Græco  
accuratissime conuersi, multisq; in lo-  
cis restituti & emendati, per

IOANNEM GVINTERIVM ANDERNACVM  
DVO ETIAM LEGVNTVR HIS APPO-  
siti indices Alter Celsionum, & Capitulorum Sum-  
mas nunc additas, continet, Alter in totoli-  
bro scitu præclara demonstrat

Que omnia recentis hac nostræ editionis, ut potuit fieri, dis-  
ligentissime expolita sunt, atque elaborata.



Venetis apud Hieronymum Scotum

κ σ ς ς

## SERIES CHARTARVM.

α ABCDEFGHIKLMNOPQRST  
VXYZ AaBbCcDdEeFfGgHh.

Omnes sunt quaterniones



Venetis apud Hieronymum Scotum.

κ σ ς ς



## REVIEWS OF NEW BOOKS

**P**ORTER'S *Elements of Hygiene and Public Health*<sup>1</sup> is a typical health officer's desk manual of the British rather than the American type. It is meaty, accurate, and detailed. It bustles with facts and experiences set down just as they are, arranged in a systematic, orderly, and orthodox way.

As is the custom with British books considerable space is given to sanitation. That part of the text dealing with environment and methods for modifying it is greater than a similar part in books produced in the United States.

There is a chapter on English laws and ordinances which makes it valuable where these laws apply, but does not help elsewhere. But at its worst, this means nothing more than a waste of space to the American reader who will find this book a good one to have right before him where he can reach for it early and often.

W A EVANS

**I**N writing his book on the conquest of disease<sup>2</sup>, Dr Rice had in mind the large clientele of lay and semiprofessional readers who seek to have intelligent opinions on health matters. It is for them he writes. What he has written states the facts as they are. The facts are correctly given and they are up to date. Those opinions which experience has not sustained he prunes out and replaces with new stuff. He knows the art of presentation and makes use of it. The work is limited to preventive medicine.

There is a short chapter on sanitation and one on administration. All the remainder deals with small pox, measles, scarlet fever, and the others of the list of communicable diseases. These diseases are of great public interest, principally because they are communicable.

W A EVANS

**D**R WRIGHT'S *Applied Physiology*<sup>3</sup> bridges the gap between physiology as it must be taught to medical students, and clinical medicine. It will satisfy to a great extent the desire of the medical student and clinician for pragmatic physiology. The book is simply and clearly written, and will be of special interest and value to the practitioner who feels that he has forgotten his physiology. The disturbed functions commonly observed in disease are emphasized. Up to date and current views are presented in most of the author's discussions. The subject matter of the book deals more with the medical than the surgical aspect of the practical bearing of physiology. Much detail and the applied physiology of the specialties, such as eye, ear, etc., have wisely been omitted. The sections on the

nervous system, circulation, and respiration are excellent and adequately dealt with, although other sections are somewhat too brief to be complete. However, any deficiency in this respect has been cared for by the inclusion of general references which the reader may consult for more complete and detailed information. It is a worth while book for the library of every student, teacher, and practitioner of medicine.

A C IVY

**T**HE textbook of exodontia by Winter<sup>4</sup> with 329 excellent illustrations, will appeal to the student as a helpful guide, because it is clearly and concisely written, and contains little extraneous matter. It outlines the mechanical principles involved in the extraction of teeth in a manner which may be readily grasped and applied.

The chapter on general anaesthesia by James Taylor Gwathmey, M.D., is all that could be desired in any book not devoted more or less exclusively to anaesthesia. The chapters on local anaesthesia are well written and the technique is sufficiently explicit to enable one to perform painlessly the operations which are described in the chapters which follow.

The illustrations are good and demonstrate the application of suitable instruments in a logical way.

H A POTTS

**A**N exposition of a method of treatment of arthritis by vaccines has been written by H Warren Crowe<sup>5</sup>. It represents solely the opinions and methods of the author. His work in this field dates from 1912 or before and apparently has been attended by considerable success. It therefore, even more than if it were the expression of recent work, deserves to be subjected to careful analysis. This is true since the powerful and magnetic clinician with a "cure" which he is directing may achieve results by the psychological force of his regime and his personality, whereas the other results are more definitely due to the curative agents alone. This is a stimulating book and it seems certain that vaccine treatment when finally understood may be of great value in arthritis. The theories of the writer are suggestive. Nevertheless it is difficult to reconcile these statements. On page 43—"uncomplicated rheumatoid arthritis, if properly treated, can always be cured" (italics by Dr Crowe), and on page 129 "of 45 cases of severe rheumatoid arthritis, there were good results of this treatment in only 55 per cent of cases."

The book contains a description of the course of vaccine treatments, a discussion of the orthopedics of chronic arthritis and a discussion of results. There are many illustrative cases. The only serious

<sup>1</sup> *A TEXTBOOK OF EXODONTIA. EXODONTIA. ORAL SURGERY AND ANAESTHESIA* By Leo Winter D.D.S. St Louis C.V. Mosby Co. 1927

<sup>2</sup> *THE TREATMENT OF CHRONIC ARTERITIS AND RHEUMATISM* By H. Warren Crowe D.M. B.Ch. (Oxon.) M.R.C.S. L.R.C.P. New York Oxford University Press 1926

<sup>3</sup> *ELEMENTS OF HYGIENE AND PUBLIC HEALTH. An Introduction to Preventive Medicine for Students and Practitioners of Medicine* By Charles Porter M.D. B.Sc. M.R.C.P. (Edin.) 2d ed. New York Humphrey Milford Oxford University Press 1926

<sup>4</sup> *THE CONQUEST OF DISEASE* By Thurman B. Rice A.M. M.D. New York The MacMillan Company 1927

<sup>5</sup> *APPLIED PHYSIOLOGY* By Samson Wright M.D. M.R.C.P. Introduction by Swale Vincent, M.D. LL.D. D.Sc. F.R.S. (Ed and Can adia) New York Oxford University Press 1926



criticism to be offered is against the too enthusiastic exhortation of the author to do just as he has done. The book would carry a greater appeal if it presented a dispassionate analysis of his work.

PAUL STARR

THE manual of medicine by Woodward<sup>1</sup> is a solid compend covering internal medicine including a consideration of diseases of the nervous system and insanity. It is concise but complete up to date and correct.

PAUL STARR

THE Year Book<sup>2</sup> volume for 1926 covers as it has done in the past the year's progress in internal medicine. A few leading contributions from each of the fields of internal medicine are discussed. The material presented is stimulating and informative.

PAUL STARR

A GROUP of interesting addresses<sup>3</sup> covering an experience of many years in the field of nursing education is presented by Miss Nutting for many years head of the School of Nursing at Johns Hopkins Hospital and now a professor of nursing and health at Columbia University. The book is particularly significant because of the high character of the author. The subject matter deals with the problems that arise in the growth and development of schools of nursing. She finds that these difficulties are due to economic pressure and traditional beliefs and the inevitable result of a singular relationship between the average hospital and its school. Provision of adequate funds for the proper maintenance of schools of nursing is proposed as a remedy.

SENA H. BRANDT, R.N.

IT is always a pleasure to read the classic of Applied Anatomy by Treves<sup>4</sup>. Written by a surgeon some forty years ago it has been preserved and revised through eight editions always clinging close to the original. It is a monument to its first author and such the new editor has kept it changing it only where newer ideas and knowledge have necessitated. Anatomically correct and surprisingly inclusive of details it is at once a text of surgical anatomy and a handbook of established surgical practice. It uses the new terminology but does not forget the names of those who have developed this science and its pages are liberally strewn with references to the old authors. It is an invaluable aid to the student in his study of anatomy and surgery to the teacher who wishes to make his subject more practical and to the

surgeon who wants to revise his knowledge of relationships and the rationale of operative procedures.

MICHAEL L. MASOY

THE first edition of Rollier's<sup>5</sup> book on heliotherapy appeared in 1923 under the same title. The second edition, the present volume has been admirably translated by G. de Swietockowski and contains little that is new but represents a rehandling of the whole subject putting it in better and more acceptable shape and adding to it many convincing illustrations.

Gauvain says in his foreword to this volume that in all ages there have been sun worshippers. To Rollier goes the credit not only for having earned our lasting gratitude by laying the sure foundations for heliotherapy but also that of establishing a pre-ent day cult of sun worship. To stand with Rollier on a sun porch looking down upon the distant beautiful Rhone valley surrounded by silent snow clad peaks which are seemingly near enough almost to touch and to hear him dramatically attribute to the bright sunlight the healing process that is going on everywhere about gives one an inkling of why sun worship has persisted throughout the ages and why Rollier himself is a sun worshiper of no mean quality.

In theory and in practice Rollier is an ardent advocate of heliotherapy. His clinic at Leyzin is crowded with patients who have the lesions of surgical tuberculosis. He is an enthusiast a propagandist and a true believer in his cause—the cause of heliotherapy.

Rollier has come to believe that the effect of sun light is to guarantee better nutrition and to maintain a healthy condition in the muscles and to assure the recovery of movement in diseased joints and beyond this to produce a psychic influence upon the patient which results in healthy cheerfulness. In fact he says: "Being in the sun enables sick people to regain their old joy in life and brings about a happy elasticity of spirits; they soon become reconciled to their condition against which they used continuously to rebel. With the sunshine enter the inward satisfaction and peace which are the beneficent results of the work cure and turn the long sojourn in the mountains from exile to a profitable stay. Sunlight is therefore unmistakably a psychotherapeutic factor of the first order."

This book is especially valuable of course to those who deal with the treatment of surgical tuberculosis. The technique of heliotherapy, the dosage of light and the methods of fixation in bed are clearly given. This book however has a definite value to medicine in general as it points out the great advantages of sun treatment in various types of diseases. It has many points for the medical profession in general. One is inclined to discount some of Rollier's enthusiasm especially as it is shown in his tables of statistics. Tuberculosis it may be said with truth

MANUAL OF MEDICINE. By A. S. Woodward. C. M. G. C. B. E. M. D. F. R. C. P. 3d ed. New York: Oxford Univ. Press, 1927.

THE PRACTICAL MEDICINE SERIES. C. M. G. C. B. E. M. D. Th. 1. Year 1. P. 1. Med. Cl. Ed. G. T. Y. D. Th. 2. General Ed. Th. 1. Barg. Th. 1. S. L. Mix. A. M. D. S. C. 9. G. Chic. G. Th. 1. B. K. P. bi. hers 1926.

A SOUND ECONOMIC BASIS FOR SCHOOLS OF NURSING. A. D. O. BER. Ad. ESSAYS By Mary Adelaide Nutting. R. N. M. A. New York: G. P. Putnam, 1926.

SURGICAL APPLIED ANATOMY. By S. Fred. Treves. 8th ed. By C. C. Choy. C. M. G. C. B. E. M. D. (Ed.) F. R. C. S. (E. G.). Philadelphia: Lea and Febiger, 1927.

HE OTHER BY WITH SPECIAL CONSIDERATION OF SURGICAL TUBERCULOSIS. By A. R. H. M. D. T. and ed. by G. de Swietockowski. M. D. M. R. C. S. N. W. J. K. O. F. D. U. ers. ty. P. 1927.

is an extremely chronic type of infection. The fact that patients improve tremendously, that they gain weight, and that their lesions become quiescent does not necessarily mean that they are cured of tuberculousis.

NATHANIEL ALLISON

A BOOK on diseases of the heart<sup>1</sup> comes to us well written, concise and complete, containing a wealth of practical information. Obviously based upon the author's own experience and investigative work, it contains comparatively few references to the literature; this gives it, at times, an air of dogmatism, yet the personal note serves to enhance its value.

The physician who consults his books for helpful suggestions in the daily problems of diagnosis and treatment will find here the matured conclusions of one who writes from his own observations and experience. Controversial matter is conspicuous by its absence. Withal the most modern developments in cardiology have not been overlooked. Due reference is made to the surgical treatment of angina pectoris and of mitral disease, and the chapter on electrocardiography is excellent. An interesting feature is the author's careful study of the pulse and his frequent references to the importance of such study, a subject which fails to receive adequate attention in these days among American physicians. The chapters upon "Physical Signs" and "Treatment in Cardiac Affections" are particularly valuable.

One statement regarding the etiological relationship of auto intoxication, especially from the teeth, the tonsils, and the colon, to subnormal blood pressure, repeated in the catalogue of the causes of hypertension, is open to criticism. Such an etiological relationship is not yet proven. Another statement that chronic valvular disease, aortic and mitral, may be the result of primary, chronic endocarditis is not in agreement with our accepted opinions.

In the short section on the treatment of acute endocarditis, reference is made to many drugs and therapeutic procedures without the simple statement that, thus far, we have no curative remedies for this disease. To some readers the catalogue of these supposed remedies is warrant for their use, perhaps to the detriment of the patient. But the merits of the book far outweigh the few shortcomings, and the reviewer takes pleasure in recommending it to any who are interested in the clinical aspects of cardiology. To such, it will afford pleasure and profit.

JAMES G. CARR

IN a little monograph Cope endeavors to place before the inexperienced practitioner those points pertaining to the surgical treatment of acute intra abdominal lesions which he believes essential

to success. Emphasis is placed on the fact that experience is the great teacher and that the inexperienced practitioner should not operate when an expert in this branch of work is within reasonable distance.

This monograph is typical of many English work—it is clear and concise and exceedingly well illustrated. For the sake of completion the author should have included the pre operative treatment of the jaundiced patient and the detoxication procedures in high intestinal obstruction. These two procedures will reduce the mortality rate in such cases approximately 50 per cent. Incidently he omits mentioning gastric lavage before operation in intestinal obstruction. The omission of this simple procedure greatly raises the hazards of the operation. The author does not stress blood transfusion in the treatment of rupture of the spleen, liver and kidney. Issue may be taken with the author regarding peritoneal lavage in perforative peritonitis, since he apparently questions its use except in those cases in which much foreign material is present in the abdominal cavity.

It is conceded that in a small monograph, such a broad subject must be covered in a brief manner, and this brevity constitutes the value of the book. There is not a line wasted on trivial matter. The little volume will be invaluable to the practitioner in a remote part of the world who must depend upon his own resources.

JOHN A. WOLFER

THE authors of *Pneumoconiosis*<sup>2</sup> are particularly well qualified to present the subject. In view of the confusion that exists in many quarters where X ray studies of the lungs are made, concerning the shadow increases in the markings of the respiratory structures, we have ample proof of the need and value of this work.

The subject matter is rationally presented and is supported by material that makes a firm basis for the conclusions drawn. In addition to the diagnostic phase of the subject of silicosis, they have shown that the prevention of pneumoconiosis is an important problem in public health and industrial medicine, and looms big in the question of liability in compensation acts.

It is well demonstrated that in many cases, conditions incorrectly diagnosed as pulmonary tuberculosis are actually inhalation changes from irritative dusts. The roentgen ray illustrations are splendid examples of thoroughness and careful technical procedure. The book will prove of great value to the roentgenologist and the industrial surgeon, as well as to the physician who deals with chest diseases. The difficulties in the diagnosis of silicosis are recognized by the authors who give much helpful material for differential diagnosis.

EDWARD S. BLAINE

<sup>1</sup> DISEASES OF THE HEART. THEIR DIAGNOSIS, PROGNOSIS AND TREATMENT. BY MORRIS MERRITT. By Frederick W. Price, M.D. F.R.S. (Edin.) New York, Oxford University Press, 1927.

<sup>2</sup> THE TREATMENT OF THE ACUTE ABDOMEN: OPERATIVE AND NON-OPERATIVE. By Zachary Cope, B.A., M.D., M.S. (Lon.) F.R.C.S. (Eng.) New York, Oxford University Press, 1926.

<sup>3</sup> PNEUMOCONIOSIS (SILICOSIS). A ROENTGENOLOGICAL STUDY WITH NOTES ON PATHOLOGY. By Henry A. Pag east, M.D. and Eugene P. Pendergrass, M.D. New York, Paul B. Hoeber, 1926.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

WALTER W. CHIPMAN *Montreal President*

GEORGE D. STEWART *New York President Elect*

FRANKLIN H. MARTIN *Chicago Director General*

## DETROIT COMMITTEE ON ARRANGEMENTS

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*Sub-Committee on Eye, Ear, Nose and Throat Surgery*

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WALTER R. PARKER

## PRELIMINARY PROGRAM FOR THE 1927 CLINICAL CONGRESS

In the following pages is presented a tentative schedule of clinics and demonstrations to be given in the Detroit and Ann Arbor hospitals as prepared by the Committee on Arrangements. The program is to be revised and amplified during the weeks preceding the Congress so that the final program will fully represent the clinical activities in the hospitals of Detroit and Ann Arbor, the medical school of the University of Michigan and the Detroit College of Medicine and Surgery. Clinics and demonstrations will be conducted both morning and afternoon on each of the four days, Tuesday to Friday inclusive. Members of the faculty of the medical school at the State University are making special plans to entertain a large group of visiting surgeons on each of the four days.

General headquarters for the Congress will be established at the Book Cadillac and Statler Hotels, both located on Washington Boulevard. At the former hotel will be found the registration and ticket bureaus, bulletin boards, exhibits, etc., while the large public rooms at the latter hotel will be utilized for clinical demonstrations and various scientific meetings.

There will be on exhibition at headquarters during the congress a replica of the Lister exhibit in the Wellcome Museum of Medical History in London, which has been presented to the College by Mr. Henry S. Wellcome.

### EVENING MEETINGS

The Executive Committee is preparing programs for evening sessions on each of the five days of the Congress. These will be held in Orchestra Hall, a new and beautiful auditorium located on Woodward Avenue convenient to the hotels.

On Monday evening at the Presidential Meeting the first formal session of the Congress, the President Elect, Dr. George David Stewart of New York, will be inaugurated and deliver the annual address. On the same evening Sir John Bland Sutton of London will deliver the John B. Murphy oration in surgery.

The meeting on Tuesday evening will take the form of a memorial to Lord Lister, this being the year of the Lister Centennial. The principal speaker will be Dr. W. W. Keen of Philadelphia, the Vester of American surgery, who was one of the first on this continent to use Lister's methods. Other eminent surgeons will take part in the evening's program. It is interesting to recall in this connection that the fellowship address at the first convocation of the Congress in 1913 was delivered by a nephew of Lord Lister, Sir Rickman J. Godlee of London, at that time President of the Royal College of Surgeons of England.

The annual convocation will be held on Friday evening on which occasion the 1927 class of candidates for fellowship in the College will be received.

## CLINICAL DEMONSTRATION

A series of special clinical demonstrations illustrative of diagnosis, operative and post operative treatment of surgical conditions, is being arranged by the Executive Committee to be held at Orchestra Hall in the afternoons and at the Statler Hotel in the mornings. These demonstrations will be conducted by a number of eminent surgeons including the following

J M Munro Kerr Glasgow Scotland  
 T de Martel Paris France  
 William J Mayo Rochester  
 George W Crile Cleveland  
 John B Deaver, Philadelphia  
 J M T Finney Baltimore  
 Hugh H Young Baltimore  
 Eugene H Toot New York  
 Barton Cook Hirst Philadelphia  
 John O Polak, Brooklyn  
 Frank H Lahey Boston  
 George P Muller, Philadelphia  
 Elliott C Cutler Cleveland  
 Wilray P Blair St Louis  
 Irvin Abell Louisville  
 C Jeff Miller, New Orleans  
 Leonard Rowntree, Rochester  
 Lillian K P Larrar New York  
 Hubert A Royster Raleigh  
 David H Ballou, Montreal  
 Samuel Iglaue Cincinnati

A symposium on traumatic surgery, dealing with the various aspects of the surgical care of the industrially injured, will be presented at the Friday afternoon session in Orchestra Hall. Much interest will center in this symposium as there will be present at the meeting representatives of industry, labor, and the medical profession.

## HOSPITAL CONFERENCE

For the tenth annual Hospital Standardization Conference a highly interesting program of papers, discussions and round table conferences dealing with everyday problems of practical interest has been prepared. The sessions on Monday morning and afternoon will be held in Orchestra Hall, and on Tuesday morning and afternoon at the Statler Hotel. On Wednesday morning, at the Statler Hotel, a symposium of papers and discussions dealing with the standardization of the ophthalmological and otolaryngological departments in general hospitals will be presented. In addition, special demonstrations of various phases of hospital administration will be conducted in the Detroit and Ann Arbor hospitals. The conference is planned to interest surgeons, hospital trustees, executives and personnel generally, and an invitation is extended to all persons interested in the hospital field to attend this conference.

## LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the Detroit session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheatres, operating rooms, and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets, which plan has proved an efficient means of providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding as the number of tickets issued for any clinic is limited to the capacity of the room assigned to that clinic.

## REGISTRATION FEE

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters during the meeting. This card, which is nontransferable, must be presented to secure clinic tickets and admission to the evening meetings.

## DETROIT HOTELS AND THEIR RATES

There are ample first class hotel accommodations in Detroit for all who wish to attend, most of the hotels being located within short walking distance of the headquarters hotels. The Committee recommends the following hotels:

	MINIMUM RATES WITH BATH	
	Single Room	Double Room
Barlum Cadillac Sq at Bates	\$2 50	\$4 00
Book Cadillac Washington and Michigan	4 00	6 00
Carlton Plaza 2931 John R St	2 50	4 00
Clifford Clifford and Duffield	2 50	4 00
Detroit Leland, Cass at Bagley	3 50	5 50
Fairbairn Columbia and John R	2 50	4 00
Fort Shelby, Lafayette and First	3 00	4 50
Fort Wayne Cass and Temple	2 50	3 50
Gotham John R and Orchestra Pl	2 50	3 50
Imperial 26 Peterboro St	3 00	5 00
Madison Lenox Madison Ave	2 50	3 50
Norton Jefferson and Griswold	2 75	4 50
Palmetto John R and Hancock	3 50	5 00
Royal Palms 2305 Park Ave	3 50	5 00
Savoy Adelaide and Woodward	2 50	4 00
Statler Grand Circus Park	3 00	5 00
Stevenson 46 Davenport	2 50	4 00
Strathmore 70 W Alexandrine	2 00	3 50
Tuller, Grand Circus Park	2 50	5 00
Webster Hall 1111 Lutnam Ave	3 00	

## PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY GYNECOLOGY OBSTETRICS UROLOGY, ORTHOPEDICS ETC

## UNIVERSITY HOSPITAL

(Ann Arbor)

## Tuesday

- REUBEN PETERSON—10 Hysterectomy for fibroid operation for ovarian cyst
- HUGH CABOT—10 Nephrectomy for tuberculosis supra pubic prostatectomy litholapaxy for stone in bladder
- F A COLLIER—10 Subtotal thyroidectomy for exophthalmic goiter resection of stomach for cancer radical operation for cancer of breast
- MAX PEET—10 Section of sensory root of gasserian ganglion removal of cerebral tumor removal of pinal cord tumor
- CARL E BADGLEY—10 Ununited fracture of neck of femur extra articular fusion of hip for tuberculosis Dunn's operation for calcaneus foot
- CARL W EBERBACH—10 Subtotal thyroidectomy for adenomatous goiter nephrectomy for tuberculosis pyelotomy for renal calculus
- JOHN ALEXANDER—10 Intrapleural thoroplasty for pulmonary tuberculosis phrenicectomy for pulmonary tuberculosis drainage of abscess of lung
- VERNON HART—10 Ober's operation for club foot Hoke's operation for clubfoot arthrodesis of knee for tuberculosis
- ALFRED S WARTHIN—10 Pathological conference
- EDWARD CATHCART—10 Suprapubic drainage of bladder (first stage prostatectomy) epididymectomy for tuberculosis endoartery for bladder tumor
- P M HICKEY—10 Dry clinic Diagnosis of bone tumor
- D A POHLE—2 15 Dry clinic Use and abuse of ultra violet rays
- C D CAMP—3 Dry clinic The role of the neurophysiologist in avoiding unnecessary operations

## Wednesday

- REUBEN PETERSON—10 Hysterectomy for pelvic inflammation abdominal sterilization
- HUGH CABOT—10 Cholecystectomy with cholelithiasis cholecystoduodenostomy for biliary obstruction appendectomy
- F A COLLIER—10 Subtotal thyroidectomy for toxic adenomatous goiter gastro-enterostomy for duodenal ulcer operation for prolapse of rectum
- MAX PEET—10 Chordotomy for intractable pain of cancer cerebral tumor section of sensory root of gasserian ganglion
- CARL E BADGLEY—10 Transplantation of tensor fascia lata for poliomyelitis open reduction of slipped femoral epiphysis step operation for ununited fracture
- ALFRED S WARTHIN—10 Pathological conference
- CARL W EBERBACH—10 Suprapubic prostatectomy urethroplasty for urinary incontinence ureterotomy for stone
- JOHN ALEXANDER—10 Thoracoplasty for chronic emphysema phrenicectomy for pulmonary tuberculosis
- EDWARD CATHCART—10 Suprapubic prostatectomy orchidectomy for undescended testis
- A S WARTHIN—1 30 Dry clinic Pathology of goiter

- G CARL HUBER—2 15 Dry clinic Development of the kidney
- VERNON HART—1 30 Arthrodesis of knee for tuberculosis tendon transplantation for poliomyelitis arthrodesis of shoulder for tuberculosis

## Thursday

- REUBEN PETERSON—10 Repair of relaxed vaginal outlet repair of complete perineal tear
- HUGH CABOT—10 Appendectomy suprapubic prostatectomy nephrectomy for tumor ureterocolostomy for stricture
- F A COLLIER—10 Cholecystectomy for cholelithiasis colostomy for cancer of rectum subtotal thyroidectomy for adenomatous goiter
- MAX PEET—10 Section of sensory root of gasserian ganglion operation for cerebral tumor
- CARL E BADGLEY—10 Synovectomy for chronic infectious arthritis Hubbs operation for fusion of spine arthrodesis of hip for tuberculosis
- CARL W EBERBACH—10 Subtotal thyroidectomy for toxic adenomatous goiter radical cure of chronic osteomyelitis pyelotomy for renal calculus
- JOHN ALEXANDER—10 Extrapleural thoracoplasty for tuberculosis extrapleural pneumolysis
- VERNON HART—10 Tendon transplantation for poliomyelitis arthrodesis of ankle for poliomyelitis transplantation of fibula for loss of substance in tibia
- DORIS WILE—1 30 Dry clinic The pre-operative treatment of syphilis in surgical cases
- F M HILKE—15 Dry clinic Graham's method of diagnosis of gall bladder lesions
- L H NEWBURN and HUGH CABOT—3 Dry clinic Nephritis and renal infections
- EDWARD CATHCART—1 30 Diverticulectomy for diverticulum of bladder excision of bladder tumor supra pubic prostatectomy

## PROVIDENCE HOSPITAL

## Tuesday

- EDWARD PANZNER—0 General surgery
- WILLIAM A HARPER—0 Gynecology
- WILLIAM F KEENE—0 Genito urinary surgery

## Wednesday

- WILLIAM J SEYMOUR—0 General surgery
- JOHN BELL—0 Obstetrics
- CEDRIC P SIBLEY—0 Genito urinary surgery
- ALLEN McDONALD—10 30 General surgery

## Thursday

- RAYMOND ANDRIPS and LOUIS MORAND—0 General surgery
- H WELLS JONATHAN and ISAAC S GELLERT—0 Gynecology
- JAMES MATHEWS—0 Orthopedics
- CHARLES J JEVTEG—10 30 General surgery

## Friday

- J A McMILLAN—0 General surgery
- JOHN BELL—0 Obstetrics
- EDWARD DOWDLE—0 General surgery
- RALPH H BOOKMEYER—10 30 General surgery

## HARPER HOSPITAL

## Tuesday

- MAX BALLIN and associates—9 Surgical clinic  
 C W HALLIDAY and C G JENNINGS—9 Goiter clinic  
 Incidence of goiter, medical aspects of goiter  
 GEORGE KAMPERMAN—9 Gynecological operations  
 WARD SEELEY—9 Demonstration Management of pelvic inflammatory disease  
 F H COLE—9 Demonstration Methods of diagnosis of ureteral obstruction  
 W K REXFORD—9 Demonstration Bladder tumors  
 R A MACARTHUR—9 Demonstration Treatment of epididymitis  
 H C SALTZSTEIN and TRIAN LEUCUTIA—9 Cancer clinic  
 A D LAFERTE—9 Open treatment of fractures  
 F C KIDNER—9 Cases of enchondromata  
 R V FUNSTON—9 Orthopedic results  
 HAROLD HENDERSON—9 Puerperal sepsis  
 O C FOSTER—9 Fetal mortality causes  
 C L STRAITH—9 Oral surgery clinic, operations and demonstration of cases  
 J J TOLAN—9 Dental infections  
 F C VALE—9 Dry clinic Surgical and medical aspects of gastric and duodenal ulcer

## Wednesday

- C D BROOKS and associates—9 Surgical clinic  
 W A EVANS—9 Demonstration Roentgenology of the gall bladder  
 NORMAN ALLEN—9 Diagnosis of gastric malignancy  
 F C KIDNER—9 Orthopedic operations  
 L J HIRSCHMAN—9 Proctological operations  
 A C HALL—9 Demonstration Industrial surgery fractures of os calcis  
 E C DAVIDSON—9 Demonstration Treatment of burns  
 T F MULLEN—9 Demonstration Dislocation of semilunar cartilage and fractures of scapoid  
 BYRON LOVEY—9 Electrical burns  
 G B CARPENTER—9 Treatment of carbon monoxide poisoning  
 G W STOCKWELL—9 Demonstration Ununited fractures  
 W A EVANS, T LEUCUTIA and C K HASLEY—9 Demonstration Radiation and electric coagulation in malignant diseases  
 E G MARTIN—9 Demonstration Cases of dysentery treated by Bergen's method  
 J J CORBETT—9 Demonstration Management of acute proctological conditions  
 H P CUSHMAN—9 Demonstration Gynecological diagnostic methods  
 I W HAYNES—9 Demonstration Diagnosis of pregnancy  
 W T SHANNON—9 Demonstration and comparison of methods in anesthesia

## Thursday

- MAX BALLIN and associates—9 Surgical clinic  
 C W HALLIDAY and C G JENNINGS—9 Goiter clinic  
 Incidence of goiter, medical aspects of goiter  
 GEORGE KAMPERMAN—9 Gynecological operations  
 WARD SEELEY—9 Demonstration Management of pelvic inflammatory disease  
 F H COLE—9 Demonstration Methods of diagnosis of ureteral obstruction  
 W K REXFORD—9 Demonstration Bladder tumors  
 R A MACARTHUR—9 Demonstration Treatment of epididymitis  
 H C SALTZSTEIN and TRIAN LEUCUTIA—9 Cancer clinic

- A D LAFERTE—9 Open treatment of fractures  
 F C KIDNER—9 Cases of enchondromata  
 R V FUNSTON—9 Orthopedic results  
 HAROLD HENDERSON—9 Puerperal sepsis  
 O C FOSTER—9 Fetal mortality causes  
 C L STRAITH—9 Oral surgery clinic operations and demonstration of cases  
 J J TOLAN—9 Dental infections  
 I C VALE—9 Dry clinic Surgical and medical aspects of gastric and duodenal ulcer

## Friday

- C D BROOKS and associates—9 Surgical clinic  
 W A EVANS—9 Demonstration Roentgenology of the gall bladder  
 NORMAN ALLEN—9 Diagnosis of gastric malignancy  
 F C KIDNER—9 Orthopedic operations  
 L J HIRSCHMAN—9 Proctological operations  
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 H P CUSHMAN—9 Demonstration Gynecological diagnostic methods  
 I W HAYNES—9 Demonstration Diagnosis of pregnancy  
 W T SHANNON—9 Demonstration and comparison of methods of anesthesia

## EVANGELICAL DEACONESS HOSPITAL

## Tuesday

- ELDEN C BAUMGARTEN and RUDOLPH L PFLEIFFER—9 Operations on gall bladder and female pelvis

## Wednesday

- ALFRED H WHITTAKER and JACOB MANTING—9 Demonstration of fracture cases and operative work on fractures

## Thursday

- LESLIE HENDERSON and DANIEL I EITHAUSER—9 Cases of gastric and duodenal ulcer, operations

## Friday

- ROBERT T TAPERT and LAWRENCE N HOST—9 Operations on thyroid and female pelvis

## WOMAN'S HOSPITAL

## Wednesday

- C H JUDD—9 Gynecology

## Thursday

- SUSANNE SANDERSON—9 Gynecology

## Friday

- ARCHIBALD D McALPINE—9 General surgery  
 WYMAN BARRETT—9 General surgery

## ST MARY'S HOSPITAL

## Tuesday

- WILLIAM J. CASSIDY—9 Tumor of cerebellum toxic goiter removal of foreign body in bronchus  
 WALTER HACKETT—9 Resection of colon cholecystectomy appendectomy  
 LEO DRETZKA—9 Decompression in skull fracture vaginal repair toxic goiter  
 LANNES CONDIT—9 Fracture of femur (open reduction) amputation of foot trephining in skull fracture  
 ANDREW R. HACKETT—9 Iott's fracture fracture of patella open reduction of fracture of humerus  
 ARMAND KERSTEN—9 Removal of tuberculous kidney suprapubic prostatectomy epididymectomy  
 LORENZO ZIMMER—9 Watkins interposition operation for cystocele (vaginal repair) fibromyomata of uterus hysterectomy  
 JOHN CORBETT—9 Demonstration of local sacral and spinal anesthesia hemorrhoid local carcinoma of rectum resection (Miles operation) prolapse of rectum

## Wednesday

- WILLIAM J. CASSIDY—9 Appendectomy duodenal ulcer (gastro enterostomy) foreign body in knee joint (removal)  
 WALTER L. HACKETT—9 Waugh's replacement of ascending colon Finney's gastroduodenostomy myomectomy  
 LEO DRETZKA—9 Cystocele and rectocele (repair) gastric ulcer (gastric resection) tumor of spine (removal)  
 LANNES CONDIT—9 Amputation of hip joint cast for fracture of os calcis fracture of patella  
 ANDREW R. HACKETT—9 Cast of tibia open reduction of fracture of humerus appendectomy  
 ARMAND KERSTEN—9 Cystoscopy removal of tumor of scrotum drainage of bladder  
 WILLIAM A. REPP—9 Appendectomy salpingostomy for sterility amputation of cervix  
 JOHN CORBETT—9 Colostomy for carcinoma of sigmoid operation for pruritus ani

## Thursday

- WILLIAM J. CASSIDY—9 Suture of ulnar nerve brain abscess (drainage) excision of knee joint resection of rib in empyema  
 WALTER L. HACKETT—9 Thyroidectomy (adenoma) carcinoma of sigmoid ovarian cyst  
 LEO DRETZKA—9 Salpingectomy for pelvic inflammatory disease carcinoma of tongue resection of rectum for carcinoma (Miles operation)  
 LANNES CONDIT—9 Removal of foreign body from knee joint cast for fracture of femur cast for fractured ribs  
 ANDREW R. HACKETT—9 Removal of bone plates foreign body in hand (removal) fractured tibia  
 ARMAND KERSTEN—9 Stone in ureter stone in bladder removal of tuberculous kidney  
 WILLIAM A. REPP—9 Hysterectomy appendectomy hemorrhoids  
 JOHN CORBETT—9 Hemorrhoids under local operation for imperforate anus rectal fistula

## MICHIGAN MUTUAL HOSPITAL

- G. C. FRANKERTH and DR. SMITH—9 Daily General surgical operations and demonstration of cases Repair of lacerations amputations reduction of fractures care of ununited fractures hernia case  
 Staff—9 Daily Demonstration in physiotherapy department

## GRACE HOSPITAL

## Tuesday

- BRUCE ANDERSON—9 Hyst. rectomy for fibroid  
 HERBERT W. HEWITT—9 Gastric surgery  
 FRANK A. KELLY—9 Herniotomy local anesthesia  
 HUGH A. HAGERTY—9 Fixation operation for procidentia uteri  
 MILTON A. DARLING—9 Vaginal plastic  
 FRANK E. CURTIS—9 Hibbs operation  
 EDWIN C. HOFF—9 Cholecystectomy  
 LEWIS E. DANIELS—9 Vaginal plastic  
 HAROLD L. MORRIS—9 Operative procedures for bilateral renal calculi  
 LEROY W. HULL—9 Scrotal surgery epididymectomy epididymotomy

## Wednesday

- HAROLD K. SHAWAN—9 Thyroidectomy  
 FRANK A. KELLY—9 Herniotomy local anesthesia  
 ROBERT J. PALMER—9 Pylorectomy  
 BRUCE ANDERSON—9 Vaginal plastic  
 LEWIS E. DANIELS—9 Hysterectomy for carcinoma of cervix  
 CHARLES S. KENNEDY—9 Gastrectomy  
 WILLIAM A. HUDSON—9 Pneumonecstomy  
 MILTON A. DARLING—9 Demonstration of lipiodol in jection of fallopian tubes  
 HARRY W. PLACGENEVER—9 Prostatectomy  
 GEORGE C. BURR—9 Cystoscopy with local anesthesia

## Thursday

- HERBERT W. HEWITT—9 Cholecystectomy  
 BRUCE ANDERSON—9 Abdominal hysterectomy for fibroid  
 WILLIAM F. BLODGETT—9 Albee operation  
 HAROLD K. SHAWAN—9 Thyroidectomy  
 GEORGE P. MYERS—9 Open reduction with bone graft for fracture of femur  
 HUGH A. HAGERTY—9 Bilateral salpingo oophorectomy  
 FRANK A. KELLY—9 Herniotomy  
 L. W. HARTMAN—9 Amputation of leg at hip joint  
 R. L. CUMMINGS—9 Tuberculosis of genital urinary tract nephrectomy dermoid cyst of scrotum

## Friday

- HAROLD K. SHAWAN—9 Thyroidectomy  
 ROBERT J. PALMER—9 Herniotomy  
 CHARLES S. KENNEDY—9 Removal of spinal cord tumor  
 WILLIAM E. BLODGETT—9 Hibbs operation  
 FRANK E. CURTIS—9 Talipes equinovarus  
 EDWIN C. HOFF—9 Operation on gall bladder and ducts  
 FRANK A. KELLY—9 Hernia local anesthesia  
 GEORGE P. MYERS—9 Resection of knee joint  
 HARRY W. PLACGENEVER and R. L. CUMMINGS—9 Carcinoma of prostate electrocoagulation of tumor

## HIGHLAND PARK GENERAL HOSPITAL

## Tuesday

- WILLIAM R. McCLEURE—9 Fracture clinic.

## Wednesday

- WILLIAM HUDSON—9 Surgery of non tuberculous suppurative disease of the lung.

## Thursday

- FRANK C. WITTER—9 Gynecological and surgical clinic

## Friday

- G. VAN AMBER BROWN—8 Plastic pelvic surgery treatment of malnancy of uterine cervix

## HENRY FORD HOSPITAL

- R D McCLEURE and A B McGRAW General surgical clinic operations and demonstration of case: the thyroid problem stomach and gall bladder problems and results blood transfusion
- J P PRATT and H M NELSON Gynecological operations and demonstration of cases, hysterectomy results of complete vs supravaginal method methods and results of treatment of sterility cause excision of endometrial implant comparison of methods of treatment radium vs operation for cancer of uterus end results
- C W PEABODY Orthopedic operations and demonstration of cases new type of osteoplastic bunion operation with end result studies chronic synovial tuberculosis spinal anesthesia in bone and joint surgery
- JOHN K. ORMOND Urological operations and demonstration of cases pyelograms and pathological material ureteral stricture foci of infection as applied in urology
- R S SIDDALL and R J Sisson Obstetrical clinic incidence of late toxemia of pregnancy and significance for subsequent pregnancy ethylene anesthesia in obstetrical pathology of the placenta and umbilical cord, developmental anomalies of the fetus and other pathological specimens
- H S CRAWFORD Neurosurgical operations and demonstration of cases, brain tumors treatment and results (slides, pathological material and patients) brain abscess technique after care and results ventriculography, some of its problems (with lantern slides) nerve regeneration the effect of physical agents upon chordotomy, technique and results
- T J SLADEN R H DUBHAM, A E KOEHLER R L JOHNSTON and associates Demonstrations with exhibits Graphic illustration of the organization of the hospital from the standpoint of the patient the curriculum of the interne critique of record methods with exposition of a new method the pre operative problem of arterial hypertension to the surgeon and after results, direct capillary studies congenital deformities of the gall bladder
- T R MENACH S J JOYCE and associates Demonstrations with exhibits Etiology of angioneurotic edema dermatological lesions (lantern slides) relationship of Kahn test to clinical syphilis (Dr Hartman)
- J G MATZEY W S HENDERSON and associates Demonstrations with exhibits Clinical evaluation of cholecystography based on 1000 cases method of preparation of patients for cholecystography general method of gastro intestinal survey method of differentiation of cases of jaundice pre operative problem of pyloric obstruction
- D P FOSTER Demonstrations with exhibits Out patient department studies in metabolism with examples obesity in relation to blood pressure use of glucose in treatment of nephritis, cases of diabetes and pregnancy
- T J HELDT GROVES SMITH and associates Demonstrations with exhibits The aid of the neuropsychiatric service to the surgeon and obstetrician
- T JANNEY SMITH L T COLVIN and associates Demonstrations with exhibits Heart lesions produced by deep X ray experimental and clinical study (with Drs Hartman Doub and Bolliger) spontaneous hernia of lung through the chest wall treatment of Stokes Adams disease with barium chloride, clinic of lipiodol injections diagnosis of lung abscess and artificial pneumothorax

- C M McCOLL D S ARBUCKLE and associates Demonstration Reception and handling of new patients in the outpatient department
- L S FALLIS A BOLLIGER and F W HARTMAN Demonstration Colloidal lead treatment of carcinoma preparation and tissue reactions
- R D McCLEURE and F W HARTMAN Demonstration Blood transfusion methods and results—a plea for standardization
- H P DOUB Demonstration Radiological studies on thoracic tumors development and response to de radiation
- T W HARTMAN A BOLLIGER and H P DOUB Demonstration Deep X ray as an agent for the production of experimental visceral disease
- T W HARTMAN Demonstration Cytology of bone tumors

## JEFFERSON CLINIC AND DIAGNOSTIC HOSPITAL

## Tuesday

- ALEXANDER W BLAIN—9 Thyroidectomy for Graves' disease
- IRA G DOWNER—10 Cholecystectomy and appendectomy
- LEO E GRAJEWSKI—11 Bilateral epididymectomy, chronic epididymitis
- DAVID F HERON—12 Oral surgery
- Wednesday
- PAUL EISEN—9 X Ray demonstration gastric ulcer
- ALEXANDER W BLAIN—10 Gastric resection for gastric ulcer
- OSBORNE A BRINES—11 Direct blood transfusion
- WEE K LIM—12 Industrial surgery

## Thursday

- IRA G DOWNER—9 Gastro enterostomy duodenal ulcer
- ROY C KINGSWOOD—10 Abdominal hysterectomy fibroid of uterus
- OSBORNE A BRINES—11 Direct blood transfusion
- HARVEY BLAIN—12 Oral surgery

## Friday

- ALEXANDER W BLAIN—9 Thyroidectomy adenoma of the thyroid
- IRA G DOWNER—10 Herniotomy, ventral hernia
- LEO E GRAJEWSKI—11 Nephrectomy pyonephrosis
- ROY C KINGSWOOD—12 Vaginal repair lacerations

## CHILDREN'S HOSPITAL

## The day

- FREDERICK C KIDNER ROBERT V FUNSTON, and F G CURTIS—9 Orthopedic operations
- GROVER C PENBERTHY and staff—9 General surgery of children

## Wednesday

- FREDERICK C KIDNER ROBERT V FUNSTON, and F G CURTIS—9 General surgery
- GROVER C PENBERTHY and staff—9 Orthopedics

## Thursday

- FREDERICK C KIDNER ROBERT V FUNSTON and F G CURTIS—9 Orthopedic operations
- GROVER C PENBERTHY and staff—9 General surgery

## Friday

- FREDERICK C KIDNER ROBERT V FUNSTON and F G CURTIS—9 General surgery
- GROVER C PENBERTHY and staff—9 Orthopedics



## DETROIT RECEIVING HOSPITAL

## Tuesday

- H K SHAWAN and C FREMONT VALE—9 General surgery  
 H F DIBBLE—9 Gynecology  
 H W FLAGGEMEYER and R E CUMMING—9 Urology  
 W E BLODGETT—9 Orthopedics  
 O A BRINES—9 Pathological conference  
 PAUL EISEN—9 X ray demonstration

## Wednesday

- H WELLINGTON YATES—9 Gynecology  
 LEO DRETZKA and CHARLES B LAKOFF—9 General surgery  
 E G MARTIN—9 Proctology  
 W E KEANE—9 Urology  
 JAMES E DAVIS—9 Pathological conference  
 J C KENNING—9 X ray demonstration  
 ALEXANDER W BLAIN—11 General surgery

## Thursday

- W J SEYMOUR—9 General surgery  
 A D LAFERTE and L I CONDIT—9 Bone and joint surgery open reduction of fractures  
 WARD F SEELEY—9 Gynecology  
 H K SHAWAN and C FREMONT VALE—9 General surgery  
 O A BRINES—9 Pathological conference  
 PAUL EISEN—9 X ray demonstration

## Friday

- ANGUS McLEAN—9 General surgery  
 FRED H COLE—9 Urology  
 LEO DRETZKA and CHARLES B LAKOFF—9 General surgery  
 L J HIRSCHMAN and J J CORBETT—9 Proctology  
 JAMES E DAVIS—9 Pathological conference  
 J C KENNING—9 X ray demonstration

## HERMAN KIEFER HOSPITAL

## Tuesday

- EARL W MAY—9 Hyperplasia of thymus in newborn  
 E J O BRIEN and G C PENBERTHY—10 Thoracoplasty surgery of phrenic nerve operations and demonstration of cases  
 L REYNOLDS—10 X ray demonstration

## Wednesday

- RUSSELL ALLES—9 Blood transfusion  
 E J O BRIEN and G C PENBERTHY—10 Thoracoplasty surgery phrenic nerve operations and demonstration of cases  
 L REYNOLDS—10 X ray demonstration

## Thursday

- C C BIRKLE—9 Demonstration Tuberculous enteritis  
 G C PENBERTHY—9 Empyema  
 W L SEELEY and staff—9 Obstetrical ward walk

## Friday

- E J O BRIEN and G C PENBERTHY—9 Thoracoplasty surgery of phrenic nerve operations and demonstration of cases  
 L REYNOLDS—9 X ray demonstration

## ST JOSEPH'S MERCY HOSPITAL

## (Ann Arbor)

- C G DARLING General surgical operations and demonstration of cases  
 I D LOREE Genito urinary operations and demonstration of cases  
 C L WASHBURN Orthopedic operations and demonstration of cases  
 H H CUMMING Gynecological and obstetrical operations and demonstration of cases  
 H M BEEBE General surgical operations and demonstration of cases

## SURGERY OF THE EYE EAR, NOSE THROAT AND MOUTH

## CHILDREN'S HOSPITAL

## Tuesday

- HOWELL L BEGLE and R Sisson—2 Eye clinic ward rounds fundus examinations  
 JACOB S WENDEL—2 Mastoid complications

## Wednesday

- R Sisson—2 Eye operations  
 WILLIAM S GOVNE—2 Mastoiditis in infants

## Thursday

- Drs WALKER and O'HARA—2 Eye clinic ward rounds fundus examinations  
 DON M HOWELL—2 Accessory sinus disease in children

## Friday

- HOWELL L BEGLE—2 Eye operations  
 J B VORTON—2 Treatment of chronic otitis media in children

## JEFFERSON CLINIC AND DIAGNOSTIC HOSPITAL

## Tuesday

- WILSON RANDOLPH—2 Chronic suppurative otitis media radical mastoidectomy  
 F T MUNSON—2 Ivory implanted in cases of ozena

## Wednesday

- F T MUNSON—2 Tonsillectomies under local anesthesia

## Thursday

- GEORGE REVAUD—2 Conservative methods in treatment of upper respiratory conditions

## Friday

- WILSON RANDOLPH—2 Extirpation of nasolachrymal duct

## ST JOSEPH'S MERCY HOSPITAL

## (Ann Arbor)

- GEORGE SLOCUM Eye clinics operations and demonstration of cases  
 R B CANFIELD Nose and throat clinics operations and demonstration of cases  
 D W MYERS—Lye ear nose and throat clinics operations and demonstration of cases

## DETROIT EYE EAR NOSE AND THROAT HOSPITAL

- B R SHURLEY and associates—2 daily Clinical surgery of the ear nose and throat in its relation to diseases of the chest and internal medicine

## HARPER HOSPITAL

## Tuesday

- GEORGE FROTHINGHAM and associates—2 Eye clinic, operations, presentation of cases, glaucoma  
 H LEE SIMPSON—2 Ethmoid and sphenoid diagnosis headache originating from nasal conditions  
 JACOB WENDEL—2 Mastoid postoperative complications  
 R H PINE and R J SISSON—2 Slit lamp technique and fundus examinations  
 PARKER HEATH—2 Arteriosclerotic changes in the fundus  
 W A DEFNET, E D KANAGA and ARTHUR HALE—2 Diagnostic demonstrations  
 WILLIAM EVANS—2 Exhibit of mastoid X ray plates

## Wednesday

- DOV M CAMPBELL DUNCAN CAMPBELL and associates—2 Eye clinic industrial diseases of the eye  
 HERMAN SANDERSON— Treatment of sinusitis  
 J MILTON ROBB— Spreading osteomyelitis of the skull  
 WILLIAM EVANS—2 Exhibit of mastoid X ray plates  
 F L RYERSON—2 Demonstration of fundus cases  
 LEE LAIRD C C WALKER and R E ANSLOW—2 Diagnostic demonstrations

## Thursday

- GEORGE FROTHINGHAM and associates—2 Eye clinic operations, presentation of cases glaucoma  
 H LEE SIMPSON—2 Ethmoid and sphenoid diagnosis headache originating from nasal conditions  
 JACOB WENDEL—2 Mastoid postoperative complications  
 H H PINE and R J SISSON—2 Slit lamp technique and fundus examinations  
 PARKER HEATH—2 Arteriosclerotic changes in the fundus  
 W A DEFNET E D KANAGA and ARTHUR HALE—2 Diagnostic demonstrations  
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## Friday

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 HERMAN SANDERSON—2 Treatment of sinusitis  
 J MILTON ROBB—2 Spreading osteomyelitis of the skull  
 F L RYERSON—2 Demonstration of fundus cases  
 LEE LAIRD C C WALKER and R E ANSLOW—2 Diagnostic demonstrations  
 WILLIAM EVANS—2 Exhibit of mastoid X ray plates

## GRACE HOSPITAL

## Tuesday

- VOSS HARRELL—2 Surgery of ethmoid  
 RAY W HUGHES—2 Surgery of maxillary sinus  
 JOHN E GLEASON—2 Plastic surgery of nose and face

## Wednesday

- WILLIAM FOWLER—2 Tonsillectomy Sluder method  
 NEIL BENTLEY—2 Tonsillectomy LaForce method  
 CHARLES C McCLELLAND—2 Tonsillectomy, dissection gas anesthesia

## Thursday

- CHARLES C McCLELLAND—2 Surgery of the mastoid  
 EMIL AMBERG—2 Surgery of the mastoid  
 L E GRANT—2 Surgery of ocular muscles

## Friday

- FRED JOHNSON—2 Surgery of lachrymal sac  
 NEIL BENTLEY—2 Tendon tucking and operation for squint  
 JOHN E GLEASON—2 Surgery of larynx

## HENRY FORD HOSPITAL

## Tuesday

- K W COSGROVE and W B HUBBARD—2 Chemical burns of the eye with experimental study  
 W T GARRETSON—2 Modification of the LaGrange operation in simple glaucoma

## Wednesday

- E L WHITNEY and G C HARDIE—2 Some interesting toxic amblyopias with accompanying charts  
 W T GARRETSON—2 Rib cartilage graft in the orbit (moving pictures)

## Thursday

- E L WHITNEY and H P DOUB—2 Diagnosis of polyp in the antrum by X ray and verified by radical maxillary operation  
 W T GARRETSON—2 Lipoma of the esophagus

## Friday

- W T GARRETSON—2 Treatment of laryngeal abductor paralysis  
 E L WHITNEY and W A SCHAEGER—2 Interocular foreign bodies their treatment with a report of cases

## EVANGELICAL DEACONESS HOSPITAL

## Tuesday

- CLIFFORD F BRUNK—2 Tonsillectomies Modified Sluder general anesthesia dissection local anesthesia

## Wednesday

- CLIFFORD F BRUNK—2 Intranasal cases Submucous resection of nasal septum drainage and irrigation of antri

## Thursday

- CLIFFORD F BRUNK—2 Tonsillectomies Modified Sluder general anesthesia dissection, local anesthesia

## Friday

- CLIFFORD F BRUNK—2 Eye clinic Muscle operation demonstration of plastic cases

## HIGHLAND PARK HOSPITAL

## Tuesday

- DOV COHOE—2 Operation Muscle advancement for strabismus Demonstration Monocular exophthalmus retnitis pigmentosa coloboma of the choroid  
 W O MERRILL—2 Needle operation for cataract

## Wednesday

- E E POOS—2 Tonsillectomies under gas anesthesia, demonstration of tuberculous eye lesions  
 C T STUBBS—2 Submucous resection of the nasal septum

## Thursday

- DOV COHOE—2 Radical operation for maxillary antrum  
 W O MERRILL—2 Tonsillectomies, modified Crowe method

## Friday

- W O MERRILL—2 Radical mastoid operation

## WOMAN'S HOSPITAL

- JOHN M CARTER—2 Tuesday Tonsil clinic

## UNIVERSITY HOSPITAL

(Ann Arbor)

*Tuesday*

WALTER R PARKER GEORGE SLOCUM and MALCOLM BOURNE—1 30 Eye operations Cataract extractions simple combined Knapp

R B CANFIELD A C FURSTENBURG and J E CROW SHORE—1 30 Otolaryngological clinic Diseases of larynx and bronchi with special reference to treatment of malignant disease of the larynx

*Wednesday*

WALTER R PARKER GEORGE SLOCUM and MALCOLM BOURNE—1 30 Eye operations Iridectomy trephine cyclodialysis extirpation of lachrymal sac

R B CANFIELD A C FURSTENBURG and J E CROW SHORE—1 30 Otolaryngological clinic Diseases of the nose and accessory sinuses observation on the treatment of atrophic rhinitis

*Thursday*

WALTER R PARKER GEORGE SLOCUM and MALCOLM BOURNE—1 30 Eye operations Anterior sclerotomy skin muscle operation for entropion Hess operation for ptosis enucleation with glass ball implant

R B CANFIELD A C FURSTENBURG and J E CROW SHORE—1 30 Otolaryngological clinic Infections of the temporal bone complications with special reference to treatment of sinus thrombosis and septicæmia

## DETROIT RECEIVING HOSPITAL

J M ROBB and DON M HOWELL Radical frontal sinus operations

J M ROBB and I S SCHEMBECK Tonsillectomies under local and general anesthesia

C F MCCLINTOCK Stellate cervical ganglionectomy

JOHN M CARTER Mastoid drainage problems X ray and surgical demonstrations of tear sac

WILLIAM S STIMMERS Slit lamp and Gullstrand ophthalmoscopic demonstration

RALPH H PINE and HAROLD D JUDS Demonstration of complete conjunctival flap in eye injuries Special eye dissections

J H SHACKELFORD Oral surgery Fractures of the maxilla and mandible

## PROVIDENCE HOSPITAL

*Tuesday*

R E MERCER—2 Demonstration of Mercers antrum tube Bilateral abductor paralysis Radical ethmoidectomy

*Wednesday*

DONALD M GRAHAM—2 Oral surgery

WILLIS POTTER—2 Technique of radical ethmoid and sphenoid operations Radical mastoid operation Tonsillectomy under local anesthesia

ROBERT BEATTIE and RAY CONNOR—2 Eye ground clinic

*Thursday*

WILLIAM P WOODWORTH—2 Submucous resection Adenoidectomy under ethyl chloride

ROBERT BEATTIE and RAY CONNOR—2 Eye ground clinic

*Friday*

A O BROWN—2 Tonsillectomy under local and general anesthesia Simple mastoidectomy

## ST MARY'S HOSPITAL

## Demonstrations

WILSON RANDOLPH Radical mastoid operation Enucleation of lachrymal sac

R G SHAW Coagulation of blood in nose and throat surgery

T P CLIFFORD Facial paralysis Keratitis

H F OHRT Syphilitic iritis

R J SIBSON Visual fields in glaucoma Strabismus

B J GLOWACKE Otalgia

E V JOINVILLE Nasal obstruction Acute otitis in children

## Operations

E V JOINVILLE Tonsillectomies removal of nasal polyp radical mastoid deflected septum foreign body in ear intectomy

## MICHIGAN MUTUAL HOSPITAL

HOWELL L BEGLE—10 daily Routine care of patients with injured eyes Discussion of industrial problems relative to injury of the eyes

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

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NUMBER 3

## DIVERTICULA AND DUPLICATION OF THE DUODENUM<sup>1</sup>

WITH REFERENCE TO THE IMPORTANCE OF CHOLECYSTITIS IN THE PRODUCTION OF SYMPTOMS

By JOSEPH W. LARIMORE, M.D. AND EVARTS A. GRAHAM, M.D., F.A.C.S.  
St. Louis, Missouri

**D**IVERTICULA of the duodenum present a particularly difficult clinical problem. A large majority of these are clinically silent, and are only casual findings. Others present difficulties because of association with concurrent upper abdominal disease. Indication for surgical interference depends upon the solution of the clinical question as to the origin of symptoms in a duodenal diverticulum or in such coincident disease. The association of ulcer with acquired diverticula is emphasized in many reports. Cases reported in this paper show cholecystitis to be the source of symptoms. That the diverticula may be the site of major pathology is also shown by many case reports. Davis (7), Baldwin (2), Wilkie (27), and Fisher (9) report cases causing death. Cancer primarily involving a diverticulum of the duodenum is reported by Morrison and Feldman (20). Gangrenous diverticulitis is reported by Huddy (13). Hunt and Herbst (14) found at operation, a fistulous connection between the gall bladder and a false diverticulum of the duodenum, gall stones had entered the latter and were unable to escape because the stomach of the diverticulum was too small.

The literature of duodenal diverticula is now relatively extensive. From the first report by Chomel (6) in 1710, to 1910 the con-

dition was discovered post mortem, or unexpectedly at laparotomy, and was considered rare. Between 1910 and 1915 the literature was concerned chiefly with X-ray demonstrations of these diverticula. During this period and since, the incidence of their discovery has increased and they have become an important clinical problem. The first operation on a duodenal diverticulum previously diagnosed by X-ray was by Forssell (10) in 1915 and from this time the literature is concerned chiefly with the surgical treatment. Andrews (1) gives a comprehensive review of the literature prior to 1921. Case (5) reviews the roentgenological reports to April, 1920. Hartung (12) recently reviewed the literature generally, and reports the clinical and roentgenoscopic findings in 7 cases.

The incidence of occurrence is given in reports from various sources as 7 per cent (Linsmayer 18), 3.8 per cent (Spriggs, 26), 3 per cent (Busch 4), 2 per cent (Case 5), and 1.2 per cent (Andrews 1). In a series of 3,446 cases having complete gastro intestinal fluoroscopic and serial film studies made by one of us (J. W. L.) diverticula of the alimentary tract have been seen in 105 cases: 9 of the oesophagus (0.26 per cent), 3 of the stomach (0.09 per cent), 19 of the duodenum (0.5 per cent), 3 of the jejunum (0.09 per cent), and 71 of the colon (2 per cent). Bell (3) quotes

<sup>1</sup>From the Departments of Medicine and Surgery, Washington University School of Medicine and Barnes Hospital.

## UNIVERSITY HOSPITAL

(Ann Arbor)

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WALTER R PARKER GEORGE SLOCUM and MALCOLM BOURNE—1 30 Eye operations Cataract extractions simple combined Knapp

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Fig. 3 A diverticular pocket created in right side of duodenal bulb by deformity resulting from an ulcer



Fig. 4 A penetrating pocket of a duodenal ulcer and not a diverticulum

necropsy and had no direct relation with the cause of death." He concludes that his cases were of the acquired type occurring at points in the musculature where the vessels penetrated. A large variety of etiological factors are suggested: congenital defects such as weakness where vessels or ducts enter or pierce the wall, anomalous buds analogous to the fetal liver and pancreatic buds, trauma, venous congestion, intraluminal pressure, ulcer, inflammation, fatty degeneration of the muscularis, traction on the wall actuated by ptosis or by the mesenteric vessels.

The X-ray demonstration of these diverticula depends upon the appearance in the vicinity of the duodenum of an abnormal side pocket which can be seen to fill and empty from the duodenum. Often this shows an air bubble. Films may demonstrate these conclusively and stereoscopic films have been of assistance. Fluoroscopy is in most cases necessary because a large orifice may allow prompt emptying, the horizontal portion of the stomach may obscure the picture, and redundant sacculations may be demonstrated as such by palpation. The majority of these diverticula are of

the superior and descending portions and lie within the circle of the duodenum. A diverticulum to the right of the duodenum even in a high position is jejunal in origin. The roentgenological differentiation of congenital acquired, and pseudo diverticula cannot be conclusive. A gall stone may give a picture suggestive of a diverticulum if observed only in association with the barium meal. Independent examination will clarify the picture. Association of ulcer will give strong presumption for the acquired type and for a diverticulitis. Prolonged retention by the diverticulum favors the possibility of diverticulitis.

Another type of diverticulum has been encountered in 2 of the cases here reported. This is a pseudo diverticulum which is an actual side pocket to the duodenal lumen. It is bypassed by the duodenal stream and shows prolonged retention. There is no defect in the wall of the duodenum and these pockets are extreme redundancies having fixed topography. Differentiation of this type can be fully made only at operation. This type of diverticulum corresponds to Wilkies (27) duplication of the duodenal

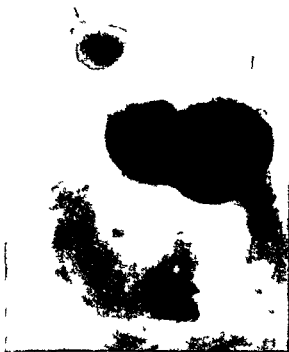


Fig 5 The anastomosis of the gall bladder to the duodenum as shown by barium entering the gall bladder from the duodenum. The anastomosis was made when the ampulla of Vater was resected for a small early carcinoma.

wall but is more marked than that which he described. He says: "On closer inspection the doubling in involves all the coats of the duodenum and the contiguous parts of the outer muscular coat at the indented area are bound together by loose fibrous tissue. The duodenal wall appears to be redundant and altogether too large for its enveloping sheath. No other mention of this duodenal redundancy has been found."

A variety of factors must be considered in determining the clinical pathological activity of these diverticula. These factors may be grouped under two heads as inflammatory and mechanical. Diverticulitis is the rule in the acquired type associated with ulcer. These are usually in the first or proximal second portions. In all diverticula there may be a more ready entrance than egress due to the small size of the stoma and to its position as above, below, or at the side of the cavity, and



Fig 6 The calybed contents of the gall bladder which cannot be conclusively differentiated from a barium filled diverticulum without observation independent of barium.

also because of the positive intraluminal pressure upon the stoma which even in a true diverticulum having a muscularis could hardly be equaled from within. Inflammation may occur as the sequence of independent upper alimentary conditions such as achlorhydria, duodenitis, gastritis, or cholecystitis.

There is no characteristic clinical picture of duodenal diverticulitis or of other complication in these abnormalities. The discovery of diverticula of the duodenum may have no other than anatomical interest. Other findings determine their clinical significance and chief among these is an exhaustive elimination of other independent upper abdominal pathology. Ulcer associated should give a clear indication for surgical care of both the ulcer and the diverticulum. This association has been emphasized in case reports by Jones (15), Murchison (21), and Penhallow (24). Symptoms when present are not pathognomonic nor characteristic. Judd (16) thinks the pain is sometimes similar to that of ulcer but is not relieved by food. Symptoms are

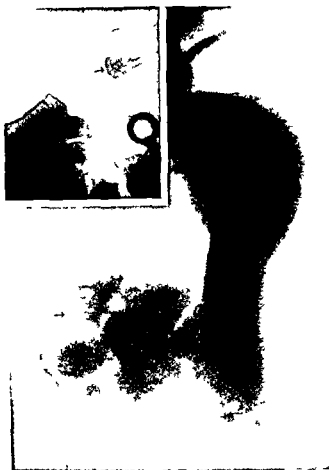


Fig 7 A large diverticulum lying within the circle of the duodenum showing a fluid level and air bubble. This diverticulum appeared to fill from the third portion. The insert shows its retention at 6 hours.

often similar to those of gall bladder disease and may be strikingly of that type with pain and jaundice. Lewis (17) reports such a case operated upon with the probable diagnosis of gall stones and a normal gall bladder was found. A diverticulum was discovered and invaginated with relief for the patient. Oehnell (23) summarizes the clinical picture of 34 cases. Ulcer was associated with 6, colitis with 5, pancreatitis with 2, and cholecystitis with only 1. Pain was prominent in 85 per cent with local tenderness in 29 per cent. Acid eructation and vomiting occurred in 44 per cent. The X ray showed associated gastric and duodenal motor disturbance in 45 per cent, and retention by the diverticulum in 76 per cent. Since other right upper quadrant disease must be eliminated before a diverticulum as the source of symptoms can be evaluated, cholecystography by the method of Graham, Cole, and Copher (11) is an essential procedure



Fig 8 A large diverticulum showing retention at 6 hours which persisted beyond 24 hours. This was definitely of origin from the proximal jejunum.

**CASE 1** A female, aged 63 years, widow, entered Barnes Hospital complaining of periods of vomiting and diarrhoea during the previous 10 years. Vomiting usually occurred immediately after eating and there was frequently abdominal pain following meals described as if "food stuck there." This was associated with heart burn and bad taste. The patient said there was "gas and distention" always after meals. These symptoms were especially prone to follow heavy meals. The bowels were alternately constipated and loose. Baking soda, often taken for burning, would cause diarrhoea. These symptoms had continued without notable variations during the 10 years. During the past year, the patient lost weight from 145 pounds to 125 pounds. Her physical examination was not notable for other than very slight tenderness in the epigastrium. The urinalysis was normal. There was an absence of occult blood in the stool, which was otherwise not notable. The gastric analysis showed an achlorhydria. Blood study showed red blood cells, 4,810,000, white blood cells 9,250 of which the differential was normal. The patient was usually very comfortable in bed in the hospital with a light diet, having no vomiting, diarrhoea, or epigastric distress. At home in the interval between her examination and her readmission for operation, she had a return of all symptoms. Hydrochloric acid by mouth gave no relief. The X ray showed a diverticulum of the duodenum in the distal third portion just proximal to the liga-





Fig. 9. The second duodenum is here atonic and retentive and appears as a diverticulum. Fluoroscopic observation easily differentiated.



Fig. 10. The redundancy of the duodenum was associated with pencholecystitis. Cholecystectomy relieved the associated symptoms.



ment of Treitz. The diverticulum showed a large air bubble; it filled partially with each passing of the barium stream and immediately almost completely drained. The duodenum proximally showed a pendulum motion very marked and striking and often accomplished reflux filling of the cap and slight return into the stomach. There was no associated colonic motor delay. The cholecystogram showed a normal gall bladder shadow.

**Operation (E. A. G.)** There was a diverticulum extending upward from the duodenum about as large as two thumbs. In order to expose this properly it was necessary to cut a part of the ligament of Treitz. The wall of the diverticulum seemed to consist entirely of mucous membrane and omentum. The muscle seemed to divide and close around the diverticulum. The diverticulum was turned into the duodenum with a purse string suture of catgut. The gall bladder seemed normal at operation.

Fig. 11 (left). The redundancy of the proximal duodenum was associated with pain and chronic dyspepsia. The progressive nature of this deformity is shown by the insert which shows the duodenum 15 months previously. Operation was not performed and cholecystography was not yet perfected.



Fig 1 The diverticulum described in Case 1. It is shown as at operation in Figure 13

The postoperative course was stormy and the patient died on the fourth day of acute general peritonitis. A partial autopsy showed no evidence of leakage anywhere. The invaginated diverticulum was still in place and the purse string suture of cat gut was holding it well with complete obliteration of the neck of the diverticulum. A pure culture of hemolytic streptococcus was obtained from the pus.

**CASE 2.** A male, aged 57 years, married, occupation a tobacco worker, was admitted to Barnes Hospital complaining of loss of appetite and severe heartburn. The present illness had begun 9 years previously when he noticed a lump in his stomach which has now disappeared, accompanied by distress in the epigastrium and distention. He was nauseated, and vomited at intervals without especial association. The symptoms have been more constant during the last 3 years with a great deal of pressure in the epigastrium, increased after exertion and radiation of this discomfort upward over the precordium. This is described as being a hot and burning sensation, also worse after exercise. This is entirely unrelated to eating. The bowels had normal daily action. There were no dietary discriminations. Weight was maintained at 150 pounds. The patient was easily exhausted and his work had been limited because of the abdominal distress. He chewed tobacco excessively. Past history showed acute articular rheumatism 10 years previously, and gonorrhea 40



Fig 13 The diverticulum in Case 1 as it appeared at operation

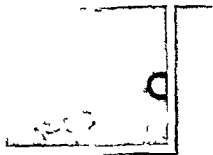


Fig 14 The pseudo diverticula in Case 2 showing retention beyond 6 hours as shown in the insert. The cholecystogram showed a pathological gall bladder. Operation showed a duodenal redundancy and folding with fixed topography explaining the diverticular pocket.



Fig. 15 The pseudo-diverticula as observed post operatively in Case 2 the same as in Figure 14. The insert shows retention at 6 hours. All symptoms were relieved by cholecystectomy.

years previously with resulting urethral stricture. Physical examination showed undernutrition of the senile type. General physique was somewhat frail. The temperature was normal. The pulse was 80. The weight was 117½ pounds. General physical examination was not otherwise notable. Laboratory examination showed a normal urinalysis, an absence of occult blood or other notable findings in the stool, 4,020,000 red blood cells, 5,000 white blood cells with a normal differential count, a negative blood Wassermann, gastric analysis with hydrochloric acid deficiency of 20 in the fasting contents of which the microscopic examination was not notable, and the test meal at 45 minutes showed free hydrochloric acid of 40. Gastrointestinal X-ray examination showed a diverticulum occurring to the left of the proximal second duodenum and apparently filling of that portion. In stereoscopic films it seemed to be directed posteriorly. It was retentive of barium beyond 6 hours. There was in association multiple diverticulosis of the colon involving the distal transverse colon, descending colon and the sigmoid colon. The distal sigmoid colon at the recto-sigmoid junction was peculiarly free; this portion being abnormally patulous. This patient was examined by the method of cholecystography which showed a pathological gall bladder having atypical position and shape.



Fig. 16 The pseudo-diverticula in Case 3 showing retention at 6 hours (insert) which persisted beyond 24 hours. Cholecystography was not developed at the time of this case. At operation redundancy of the duodenum was demonstrated to form these pockets. Cholecystectomy relieved all symptoms. Postoperative roentgenology showed persisting similar pockets slightly less retentive.

**Operation (E. I. G.)** An upper right rectus incision was made and the duodenum carefully exposed for a distance of about 9 inches from the pylorus. No evidence of ulcer or of actual diverticulum was found but there was an enlarged fold of duodenum about 5 inches from the pylorus which was bound over to another part of the intestine somewhat like a diverticulum. It seemed as if some barium could be seen shining through the wall at this place. The gall bladder had thin walls but was adherent to the omentum and the ampulla was adherent by thin, filmy adhesions to the duodenum. The liver had a good deal of fibrous tissue in its capsule. All of the upper abdominal organs were ptosed somewhat. The fold of duodenum above described was merely freed and nothing further was done to it. It did not seem advisable to invert it and turn it in like a diverticulum because it was not a real diverticulum. The appendix was removed in the usual way and seemed to give some evidence of chronic trouble. The gall bladder was also removed from below upward. A piece of liver was removed for microscopic examination. A small rubber dam drain was inserted and the wound closed in layers. Microscopical diagnosis: chronic cholecystitis, chronic hepatitis, chronic appendicitis.

A postoperative gastro intestinal X ray examination showed an accentuation of the redundant fold of the second portion of the duodenum beyond that of the pre operative examination, but at this time the side pocket was more characteristic of a redundancy than of a real diverticulum. It did, however, retain barium beyond 24 hours. The patient was relieved of his symptoms.

CASE 3 A male, aged 59 years, married, was a carpenter. The present illness began 25 years previously, and approximately twice yearly an attack of severe epigastric pain had occurred. These attacks came on usually several hours after eating. The pain was very severe, of a cramping character with slight associated nausea and no vomiting. The attacks lasted several hours irrespective of measures used. Hypodermics were not used. Each attack was followed by a short period of severe diarrhoea. The bowels had generally shown a tendency to constipation. The last previous attack was in December 1924. Physical examination showed a well nourished man. The liver was palpable two finger breadths below the costal margin. There was a right inguinal hernia, easily reducible. The urinalysis was normal. Blood study, showed red blood cells 4,990,000, haemoglobin 90 per cent, white blood cells 6,750 of which the differential was normal. The gastro intestinal roentgenogram showed two diverticula of the duodenum, one of the proximal second portion and the other of the distal third portion, and there was an associated gastric motor insufficiency of slight degree, functional in character. These diverticula retained barium for 24 hours. There was an accompanying slight colonic motor delay. This patient was examined before the development of cholecystography.

Operation (E A G) 'The entire duodenum lent itself well to a good exposure and examination but no diverticulum was found, although there were numerous adhesions between the gall bladder and the duodenum. The gall bladder wall was thickened—cholecystectomy, appendectomy. It was believed that the distortion of the duodenum was produced by adhesions.' Postoperative gastro intestinal X ray examination showed the pseudo diverticula of the duodenum which were considered at the previous, pre-operative observations as true diverticula. They had similar capacity and topography, but did not show such prolonged retention as previously. This patient was seen at intervals after his operation. He had remained entirely well for 2 years after the operation when last seen. The symptoms of which he complained were obviously due to the chronic cholecystitis and not to the retention in the diverticulum like redundancies of the duodenum.

#### SUMMARY

The X ray findings of duodenal diverticula are presented as seen in various types. A

pseudo diverticulum is described as a necessary third classification in addition to the true and the false types. Such pseudo diverticula are redundant duplications of the duodenum within its retroperitoneal sheath and have a fixed topography. They operate as diverticula. They are probably congenital in origin. Differentiation from the true or the false type cannot be made prior to operation or autopsy. Three operated cases are reported one of a large false diverticulum and two of pseudo diverticula. These last two cases had pathological gall bladders the removal of which relieved all symptoms although the duplication or practical diverticular side pockets of the duodenum persisted. Emphasis is given to consideration of the gall bladder in evaluating symptoms with which duodenal diverticula may be found associated. Cholecystography, by the method of Graham, Cole, and Copher, has made possible such adequate gall bladder diagnosis and is an essential procedure in these cases.

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# A STUDY OF THE MALIGNANT BREAST BY WHOLE SECTION AND KEY BLOCK SECTION METHODS<sup>1</sup>

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R. k. P. f. f. C. l. s. t. g. y. U. n. r. t. y. f. E. l. b. r. g. h.

I VENTURE to present to you today certain thoughts regarding carcinoma of the breast—aspects of the disease which would seem to be revealed when the tissue affected is submitted to investigation by one or other of the whole section methods.

If this study has had one effect above all others it is that it has impressed us with the value of whole section pathology with the importance of a bird's eye view so to speak of the entire field in which pathological changes may be anticipated. I feel that too often we may say with Pope:

’Tis but a part we see and not a whole.  
The method of cutting the windowpane block has its advantages no doubt it presents us with the picture of the hub of the pathological condition but the spokes and the rim are equally vital to the life of the wheel and it would seem that we sometimes forget what we may call the peripheral pathology of disease.

## MATERIAL AND METHODS

Fifty malignant breasts have been submitted to examination by the methods to be presently detailed and we are indebted to many of our colleagues for the assistance they have so ungrudgingly given in affording material. In addition to the obviously pathological material a number of presumably healthy breasts were examined in order to observe the changes of physiological states and to detect early pathological features.

The method of investigation requires a word of explanation.

The breast together with its coverings related fascia and muscle was fixed in Jore's fluid immediately after removal. When fixation was complete the breast was cut in such a way that the center of the nipple and the center of the tumor lay in the same plane. Each half breast so obtained was then divided

into a series of slices each measuring roughly 1 centimeter in thickness. The various slices comprising one half of the breast were embedded in celloidin after the usual alcohol and ether preparation and cut with a large sliding celloidin microtome. It was an easy matter to number the slices in serial order and to orient the upper and lower surfaces respectively by a simple mark.

The slices of the remaining half of the breast were investigated by the 'key block' method. The whole celloidin section while it affords an excellent general appreciation lacks the finer cytological detail of a paraffin section and therefore if the eventual picture is to be complete in its ultimate detail paraffin sections stained if necessary with specific stains must be available. The method we have followed has the advantage of simplicity.

The central surface of each slice of breast tissue is photographed to actual size or drawn in outline. The picture which constitutes the model is subdivided into a number of blocks or squares of suitable size each block is numbered and the corresponding slice of tissue is then divided into its component blocks according to the scheme in the outline of the key or plan. Each tissue block being numbered according to the figure on the key. Care must be taken to orient each block in respect of its various surfaces and borders otherwise confusion will arise. This may be conveniently done by embedding threads of different colors in each block so that the various surfaces and edges are defined. In this way perfect orientation is secured.

With a series of whole celloidin sections on the one hand and a key block system of paraffin sections to afford the more intimate cytology of the opposite half of the breast we have as complete a picture of the various pathological changes as it is possible probably

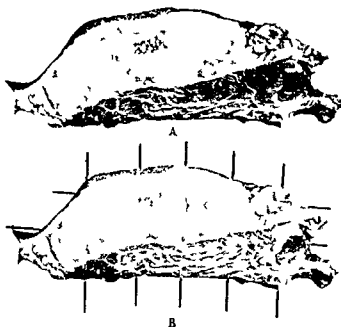


Fig 1 Examination of a malignant breast by the key block method A A thin section of the tumor bearing breast B The section is divided according to the plan shown in the photograph and each numbered block is embedded and sectioned

to obtain, a picture in which the entire breast area is brought under review. We must, however make the confession (if confession it be) that we have not cut each and every block completely. We began the investigation with the best intentions, for it was our aim to stain mount and examine every tenth section, but, if the spirit was willing the flesh was weak. Nevertheless we have attempted to investigate each breast on the lines which we have described.

#### THE HISTOLOGICAL PICTURE

The study had not been long in being before it became evident that if the true significance of the morbid is to be appreciated, it must be approached through the portals of a careful study of the normal. While this principle must necessarily hold good to some extent in all pathological problems its importance is intensified in breast pathology for we are dealing with an organ the physiological life of which witnesses and experiences a wealth of change a continuous interaction between glandular and supporting structures, and a constant reproduction and adjustment of tissue which is amazing in its resource.



Fig 2 Mammary area of embryo (16 centimeters) The formation of the epithelium invaginating cup is well shown (X 15)

#### THE DEVELOPMENT OF THE MAMMA

To make the picture a more complete one I show you a section through the mammary area of a 16 centimeter embryo about the beginning of the third month of development and you will see the process of downgrowth of the epithelium which results in the formation of a cuplike invagination. Embryonic skin is composed of two layers the superficial flattened in outline several cells in depth and constantly desquamating on the surface obviously a product of the second deeper and more stable layer. This deeper stratum is a single layer of cubical cells spheroidal in shape and provided with large nuclei containing abundant chromatin.

When the mammary invagination occurs, it is the deeper layer which is activated, the individual cells altering in shape from the original cubical into a more columnar like arrangement, the nuclei collecting at the peripheral poles of the cells. Proliferation continues as it did before invagination occurred and the center of the cup is filled with a collection of cells derived from the deeper columnar like layer.

In the further development—the budding of solid epithelial cords into the surrounding mesoblastic tissues—it is the deeper layer of cells which plays the primary part in any fresh activity of growth. It is therefore apparent that to a most unusual degree a single type of cell is responsible for the development and structure of the mammary parenchyma.

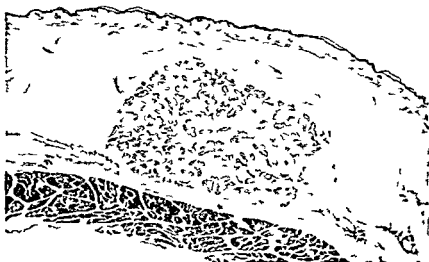


Fig 3 Section through mammary area of child six months old There is considerable tissue activity and the section shows large numbers of new acini

#### THE LATER GROWTH

I remind you that throughout the early months of postnatal life the breast exhibits a phase of considerable activity. I show you a section of the mammary region obtained from a child 6 months old. The solid epithelial cords of the embryonic state are now canalized and lined with one or two layers of cubico columnar cells. Cell proliferation is proceeding and the lumina are filled with proliferated and degenerated cells. A greenish golden pigment is scattered in droplets



Fig 4 The virgin breast (intermenstrual stage) The corpus mammae is mainly stroma supporting ducts there is virtually no acinar tissue

throughout the cells or collected into larger globules the pigment is evidently the fore runner of colostrum. A point of significance in view of future changes is the comparatively small amount of stroma the gland is a mass collection of small ducts overshadowing in proportion the comparatively scanty amount of stroma or connective tissue element. This phase however is a passing one for by the end of the first year the parenchyma activity has subsided and the organ consists of a group of simple ducts twelve to fifteen in number converging to the nipple and supported by a matrix of fibrous connective tissue.

With the advent of puberty we find a further distinct and intense stimulus of the parenchyma portion of the gland. From the original ducts lateral branches appear by a process of budding and canalization so that in a gland in which the stroma hitherto predominated to an overwhelming extent we now find a corresponding increase of the ducto acinar tissue.

The puberty change like that which occurs at birth is a passing one and the breast settles down into a phase of comparative stability which is interrupted to a minor degree it is true by the occurrence of each menstrual period. The postpuberty

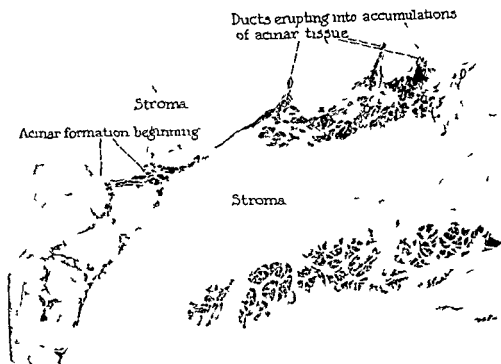


Fig 5 Virginal breast (menstrual stage) There is an intense formation of acinar tissue from the terminal portions of certain ducts

phase is conveniently described as the period of "the virginal breast," and much interest attaches to the cycle of structural changes which distinguish it

#### THE VIRGINAL BREAST

Rosenberg,<sup>1</sup> in a paper published in 1922, stated that the virginal breast of the intermenstrual period contains virtually no acini, but consists of ducts lined with epithelium and supported by a fibrous stroma. Coincident with ovulation and the formation of the corpus luteum budding outgrowths appear in the wall of the ducts, and a rapid multiplication of epithelial cells takes place, giving rise to large numbers of small lobules of glandular tissue which are virtually outgrowths of duct lining epithelium. When impregnation does not occur, and when the corpus luteum retrogresses, the lobules break up so that during the intermenstrual period they have virtually disappeared.

Polano<sup>2</sup> and Sebening<sup>3</sup> have worked at similar aspects of the question, but, while

Rosenberg's material was entirely post-mortem, theirs was derived from the living subject. In general they agree with Rosenberg's findings except that they deny that the postmenstrual retrogression is so complete as he states it to be.

The recent work of Dieckmann<sup>4</sup> suggests that the absence of acini in the virginal breast which Rosenberg described may have a developmental or even a pathological explanation, for he showed that as a whole the patients in whom Rosenberg found no acini were younger than those in whom acini were present. Dieckmann regards the non-acinar breast as representing an infantile type which had not yet developed acini, and his findings are more in agreement with those of Polano and Sebening that postmenstrual retrogression is never complete. Dieckmann has described in detail the cellular changes which distinguish or characterize the menstrual period—an œdema or vacuolation (Lappchenœdem) of the outer layer of the two celled layer of the acinar epithelium and a later œdema of the interlobular stroma.

<sup>1</sup> Rosenberg. Ueber menstruelle durch das Corpus Luteum bedingte Mammaveränderungen. Frankfurter Ztschr f Pathol 1922 xxvii

<sup>2</sup> Polano. Ztschr f Geburtsh u Gynaek 1924 lxxviii 363

<sup>3</sup> Sebening. Arch f klin Chir 1925 cxxxiv 404

<sup>4</sup> Dieckmann. Arch f path Anat etc 1925 cclvi 321





FIG. 6 Senile breast. The breast stroma is condensed; there is a comparatively small amount of acinar tissue; the ducts are moderately dilated.

Whatever minor differences there may be between the findings of these individual investigators, the consensus of their work bears evidence to the repeated progression and retrogression to the instability in fact which distinguishes mammary tissue of the virginal period for the breast undergoes changes with each monthly cycle and though there may not be as yet uniformity of opinion regarding their precise nature it is agreed that the changes form a part of the general cyclical phases of sexual maturity.

It is further evident that it is the parenchymal tissue which responds to the stimulus which the sex gland hormone is supposed to excite and one of the most impressive features of these various changes is the adaptability of this parenchyma, its power of proliferation in response to stimulus, its ability to retrogress when the demand has passed. It is difficult to suggest a parallel in any other portion of the body tissue.

Thus it is that the process of progression and retrogression is continued as though in preparation for the highest goal of its functional life, the lactating breast, a state in which the cellular activity, both in degree and duration transcends all that has gone before.

#### THE SENILE BREAST

Subsequent to the menopausal phase the mammary tissue passes into a period of what may be termed terminal stability, a state in which the healthy proliferation of the paren-

chymatous element ceases to appear. The term senile breast has sometimes been applied to the tissue of this period but the description is used not so much in respect of age as in relation to the condition of the breast tissue. The senile breast may be said to show three outstanding histological characteristics: the stroma preponderates markedly over the parenchyma, any small amount of acinar tissue which exists is wasted and atrophic and (what is of particular significance in the view of many observers) there is an overgrowth of the elastica tissue in relation to ducts and acini. Cheatele<sup>1</sup> has described the precise arrangements of cells and supporting structures in relation to the ducts and acini. The smaller ducts are lined with a single or double layer of columnar like cells and these are continued with no appreciable change unless it be a slightly more cubical shape into the acini. The cells of both ducts and acini rest upon a delicate single layer of unstratified muscle fibers, a structure to which Bender first drew attention. A delicate basement membrane underlies the muscle layer and then there exists a well marked layer of fibrous tissue to which Cheatele has given the name of the intraelastica. This layer is bounded by a thin layer of elastic tissue, the elastica, a structure which surrounds the ducts but which is not prolonged over the acinar wall. More superficially there is a layer of unstratified

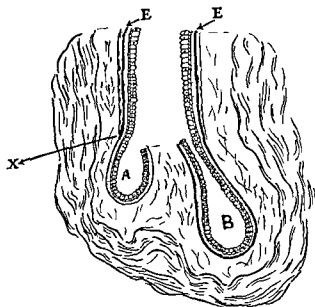


Fig 7 The distribution of the elastica in relation to duct and acinus A The elastica has terminated before the acinus structure begins B The elastica is continued over the acinar outline (Modified from Cheatele)

muscle fiber the distribution of which is limited to the wall of the duct. Each collection of acini in the related duct or ducts constituting a lobule is set in a groundwork of fibrous connective tissue which is somewhat looser in structure than that constituting the bulk of the breast stroma. The absence of elastica over the acinar surfaces (which



Fig 8 Section of senile breast showing the development of elastica around the duct termination ( $\times 60$ )



Fig 9 Epithelioma of breast A section of the tumor has been prepared for examination by the 'key block' method

are virtually the smaller duct cul de sacs) is explained by the incidence of functional activity and cell proliferation which characterize the region. It is obvious that the existence of an elastica covering in this situation would greatly limit the field of cell proliferation, in other words would limit the formation of new acini.

In the senile type of breast special significance must attach to the reaction of the elastica. Berka<sup>1</sup> publishing in 1911 the results of a detailed research into forty six breasts and studying the relationship between the stroma and the glandular tissue, con-

Berka Frankfurter Zeitschr f Path 1911 VIII 203



Fig 10 Cell nest formation in epithelioma of the breast ( $\times 60$ )



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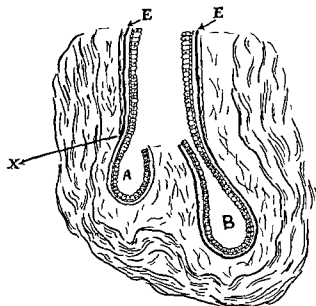


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Berka. Frankfurter Zt. chr. f. Path. 1911 vii 203

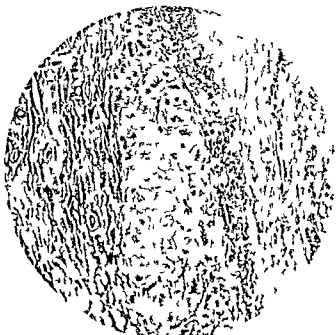


Fig. 9 Section of senile breast showing the development of elastica around the duct termination ( $\times 60$ )



Fig. 10 Cell nest formation in epithelioma of the breast ( $\times 60$ )

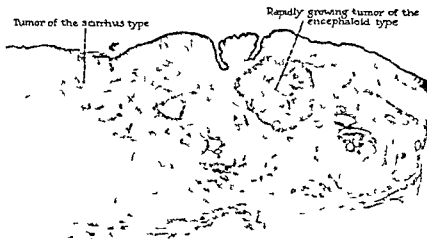


FIG. 11 To illustrate the fact that various types of tumor formation may occur in the same breast

sidered that the elastic tissue ordinarily increased in amount with advancing years and that apart from the question of age its increase is a mark of decreasing functional capacity of the organ. It is characteristic of the senile breast that not only is the elastic tissue increased in amount but it is found to exist in situations in which it is not normally present in the interacinar tissue and within the glandular lobules.

It is evident that after a certain age the formation of elastic tissue in breasts must be considered as a normal feature; indeed it is possible that its absence may be a fact of some significance.

We have said that the term senile is employed not so much in respect of age as in relation to the state of the breast tissue and we may add that as far as statistical evidence can help us the development of the senile breast is hastened by certain constitutional and clinical conditions—the absence over a prolonged period of the normal menstrual stimulus as in prolonged amenorrhœa, the absence of the states of pregnancy and lactation and possibly the overstimulus which is apt to result from repeated pregnancies.

We have attempted to outline the leading changes which characterize the physiological life of the breast and the sequence we have recited is surely an interesting progress of events. The miraculous power of acinar

development is an impressive feature it characterizes the premenopausal period and because of the association of events there would seem little doubt that this development arises secondary to the stimulus of a sexual gland hormone. With the advent of the menopause hastened it may be by the abnormal clinical states we have mentioned it would seem as though the need for the development of new ducto-acinar tissue having passed the duct terminations which remain are sealed up by the development of an elastica which normally existing around the ducts now extends over the acini and even enters the interacinar tissue.

With this impression therefore, of the physiological breast and its associated conditions let us notice certain of the impressions we have received from a study of the malignant breast.

#### THE TUMOR CLASSIFICATION

Many investigators have complained of the confusion and obvious redundancy which at present exist in connection with the terminology and classification of breast tumors. In a recent search of the literature we tabulated nineteen reported varieties of tumor formation while Deaver and McFarland<sup>1</sup> in the course of a protest against this unsatis-

De v r J B d M Farland J The Breast A omalies D ceases and Tr atm of p 451

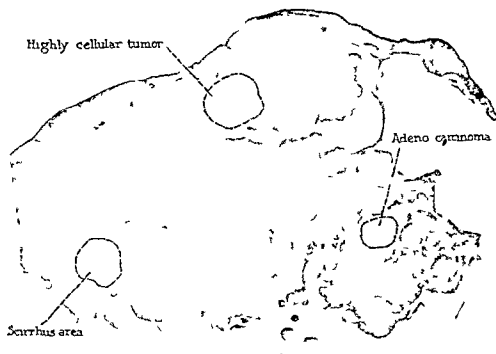


Fig 12 Breast No M1 showing different varieties of tumor (Semi-diagrammatic)

factory state of affairs record fifty four different classifications of mammary tumors Dr Lane Claydon<sup>1</sup> in her recent report to the British Ministry of Health draws attention to the obvious anomaly, and in connection with the statistics which she elaborated she suggests that the cellular characteristics of the tumors permit of their classification into one or other of the three following groups (a) spheroidal celled carcinoma (mainly fibrous), (b) spheroidal celled carcinoma (mainly cellular), (c) columnar celled carcinoma. We welcome the simplicity of this arrangement, but it is scarcely sufficiently embracing.

I show you a celloidin whole section of Breast No 440 obtained from a subject 52 years of age. Clinically there was a malignant tumor occupying the center of the breast. A history of a slight blood stained discharge from the nipple suggested the proximity of the tumor to one or other of the larger ducts, but the growth was deeply situated and not related to the skin or the overlying nipple. The clinical characters of the tumor, in fact were those of an ordinary mammary carcinoma.

<sup>1</sup> Lane Claydon. Cancer of the breast and its surgical treatment. Reports on Public Health and Medical Subjects. British Ministry of Health NIO 28 p 43

But let us see what the histological detail of the key block section reveals. In certain areas of the tumor (and thus point illustrates the importance, in fact the necessity, of a more general examination), we find characteristic cell nest formation. This tumor is a squamous celled epithelioma, developing evidently from epithelium in the termination of the larger ducts, a squamous celled carcinoma must, therefore, be included in the simple category we outlined above.

But is any hard and fast classification dependent on the type of cell and the relationship of the fibrous tissue applicable to each individual breast? If we examine a series of whole breast sections we find that there is often no uniformity of structure throughout the extent of the growth. I show you a characteristic example of this truth. Breast No 111 is the site of an extensive tumor formation. To the left of the nipple there is a large mass of disease, to the right of the nipple there is a smaller nodule. I believe that the tumor on the left was the original one, and that the swelling on the right arose secondarily, yet they are now very different in structure. A is a type of tumor which would be classified as a scirrhus carcinoma, B resembles the highly cellular tumor with only a trace of



Fig. 13. Extensive tumor formation yet showing wonderful localization

fibrous tissue the variety which is usually spoken of as encephaloid. Again Breast No. MI in part of its tissue shows the structure of an adenocarcinoma while a section taken 2 centimeters distant from this portion has the dense fibrous stroma of a scirrhus cancer.

At this stage I do not attempt to come to any conclusion as to which of these types represents the structure of the original tumor, rather am I anxious to show that in many breast tumors there is no uniformity of struc-

ture and accordingly any classification which is based upon the cytological detail of a small section of the growth is apt to be misleading.

I am unwilling to enter into debate regarding the histogenesis of breast cancer because not being a pathologist I am fully aware of my own limitations in this branch, none the less one of the reasons which prompted this investigation was a desire to throw some light on the obscure problem of the early development of breast carcinoma and the cell tissue from which the tumor takes its origin.

Ewing<sup>1</sup> in his recent volume on neoplastic diseases classifies breast carcinoma on anatomical features into three groups: adenocarcinoma arising chiefly in cysts of ducts or sweat glands; duct carcinoma arising from the lining cells of the duct; acinar carcinoma, arising from the epithelium of the acini. These various types virtually include all the epithelial sources which the breast contains but when this statement is analyzed and rearranged on a simpler basis it may be taken as meaning that tumor tissue originates from (1) the epithelium of ducts and acini; (2) the epithelium which lines the sweat glands.

Let us consider the second of these groups Creighton whose book on the *Physiology and Pathology of the Breast* published in 1886 is a mine of useful and interesting information showed that, while the breast as a whole



Fig. 14. Cancer cell infiltration limited to one side of a fascial spur (X 60)

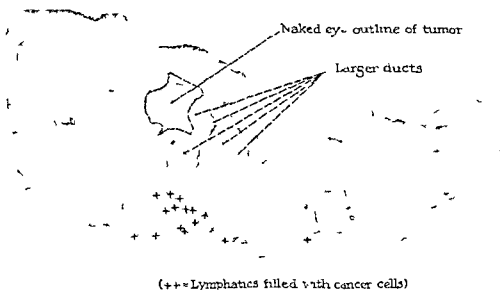


Fig. 15. Whole celloidin section of malignant breast illustrating the distribution of lymphatic dissemination

develops, certain parts may remain in a rudimentary state. This primitive breast tissue consists of tubules of a sweat gland type arranged in ill formed whorls of a fetal or infantile pattern. In a later publication Creighton stated his belief that this tissue formed the sole origin from which breast carcinoma arose.

Von Saar<sup>1</sup> and Krompecher<sup>2</sup> while not agreeing with the generality of Creighton's assertions, supported his view that tumors may originate from this source, and Ewing<sup>3</sup> stated "Cancer does not develop from the ordinary normal secreting parenchyma or ducts of the breasts but from redundant sweat glands not properly incorporated in the breast." It is obvious that Ewing must have modified his views since this was written.

It is evident therefore that there is a considerable body of recorded evidence that breast carcinoma may on occasion originate from nests of imperfectly developed mammary tissue. The term 'sweat gland' is misleading, the epithelium is of a sweat gland type, but surely it is less confusing to speak of it as a fetal or infantile type of mammary epithelium.

There is no doubt that "rests" of this description occasionally form the center from

which breast tumors develop. In this event the early tumor is isolated from the corpus mammae and forms an independent swelling usually superficial to the mamma. The percentage of these tumors is small however, there were two in the present series both early cases and in both a distinctive clinical feature was the fact that the tumor was distinct from the corpus mammae.

The epithelium which lines the ducts and acini remains the other available source. One asks oneself is there any valid reason for attempting to distinguish between a duct and an acinar origin? The lining epithelium is a continuous structure, and except in the squamous type of the terminal ducts there is virtually no structural distinction between duct and acinar varieties. That there is a distinction however in respect of growth is evident. We have made repeated allusion to the faculty which the breast possesses of producing and regressing acinar tissue, this ability evidently centers in the epithelium which lines the terminations of the smaller ducts for it is from these that new acini primarily develop. Judging by the degree of cell instability upon which this power must naturally depend, this is the region on which one's suspicions would fall if one argued upon a purely deductive basis.

There is a structural peculiarity which may be of importance in relation to this

<sup>1</sup> Von Saar: *Ergebn d. Chir. u. Orthop.* 1910 411

<sup>2</sup> Krompecher: *Verhandl. d. deutsch. Path. u. Gynaek.* 1913 vii 365

<sup>3</sup> J. Cancer Research 1916 i 385



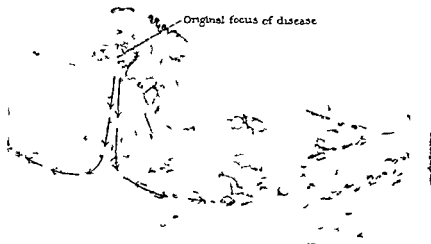


Fig. 16 Scheme of lymphatic dissemination in early central cancer as shown by plotting out infected lymphatics

question. It has been described how the zone of distribution of the elastica and its related tissue terminates before the acinar region is reached. It is only in the senile type of breast that the circumacinar and interacinar distribution is found and it is naturally suggested that this arrangement permits the development of acini during the functional period and that when the demand for acinar development is over the elastica extends its boundaries and so to speak seals up the duct cul de sacs. The freedom from restraint which the absence of elastica implies suggests that the cul de sac epithelium might readily extend beyond its natural boundaries into the parts around. In fact the interesting hypothesis may be put forward that breast carcinoma develops because the elastica which ought to seal the duct termination has failed to do so. We hasten to add that we have no direct proof at present of this view but from the evidence which we possess the supposition has a basis more secure than a pure hypothesis. That many breast carcinomata develop from duct epithelium apart from that which lines the duct cul de sac is a matter of everyday observation and one beyond any possibility of dispute.

If I may summarize these somewhat rambling and inconclusive statements I would say that whole section' investigation has

revealed the fact that a primary carcinomatous change most frequently originates in the epithelial tissue lining the ducts. In certain rare instances the tumor growth apparently originates in mammary rests of the so called 'sweat gland' type. *Ex hypothesi* the unstable epithelial tissue of the terminal ducts would seem to be the most likely source from which a carcinoma would develop but of this change no confirmatory evidence has been obtained.

#### THE SPREAD OF THE DISEASE

It seemed that a study of whole sections might afford a means of investigating the methods of spread of the disease and in pursuance of this idea a large number of outline charts were made upon each of which the various points of tumor incidence were located and recorded. Certain facts of interest were noted from this study.

Let me put this question of local spread and permeation in the simplest possible terms. It is conceivable that a malignant tumor having originated in the breast may extend along one or more of four different routes—

- A Along the lines and planes of fascial tissue or by tissue infiltration irrespective of any anatomical feature
- B By the lymphatics
- C By the blood vessels,

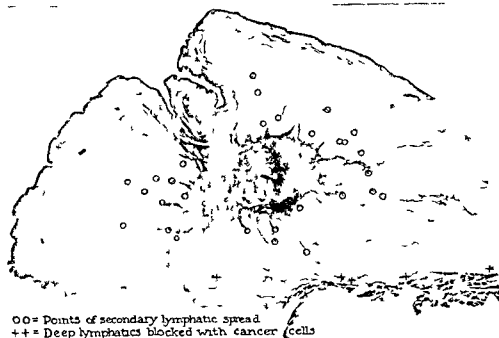


Fig 17 Celloidin whole section of malignant breast. The primary lymphatic dissemination has become occluded and secondary channels are opening

D Along the continuity of the mammary ductal system

A *Tissue and fascial permeation* We have received three distinct impressions in observing this aspect of tumor spread. The first is that tissue permeation is by no means so manifest in breast carcinoma as one had imagined it to be. Moreover, there is the curious fact that the more extensive the tumor the less is the degree and extent of tissue permeation, while in the early tumor tissue permeation and infiltration are more extensive. It is evident that, as the disease advances, tissue resistance is effectively stimulated.

The second impression concerns the distribution of the lines of spread. The fascial plane is the permeation line most frequently followed, actual infiltration of breast tissue apart from fascial distribution is less common. Even in the fascial distribution there is a curious selective influence for which it is difficult to advance any definite explanation. Time and again it will be observed that one side of a fascial line is infiltrated while the other side is free. It is apparent that the cancer cells follow the lines of least resistance, and that the distribution is largely guided by the degree of tissue tension which exists.

The third impression is in relation to the wonderful degree of immunity which striped muscle enjoys from the invasion of carcinoma cells. Even in the most advanced examples of the disease, cases in which the cancer is resting upon the pectoral muscle and the overlying fascia is extensively involved, the muscular tissue either remains free from disease or is invaded only over a superficial area of its extent. It would be interesting and possibly important to explain this curious selective resistance of muscle.

B *The local lymphatic spread* Langhans was the first to draw attention to the part which the mammary lymphatics play in conveying the tumor cells beyond the growing edge of the disease throughout the breast substance, and this pioneer work was elaborated and confirmed by the classical researches of Heidenhain<sup>1</sup> and Stiles.<sup>2</sup> We have, moreover, the account which the majority of textbooks give of the cutaneous lymph arrangements, and much is often made of the importance of this lymphatic distribution in relation to mammary carcinoma, the influence of the subpapillary plexus described by Sappey,<sup>3</sup> and particularly that

<sup>1</sup>Heidenhain Arch f klin Chir 1889 p 97

<sup>2</sup>Stiles Brit M J 1899 i 1454

<sup>3</sup>Sappey Vaisseaux Lymphatiques p 17



Fig. 18. Extensive breast carcinoma invading skin. Note that the lymphatic dissemination is within the submammary group.

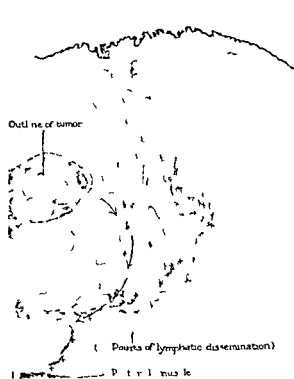


Fig. 19. Whole cell and section showing points of lymphatic dissemination from tumor.

portion of the plexus which lies in the subareolar tissues.

It was felt that the present investigation afforded an opportunity of recording the intramammary lymphatic spread and an indication has already been given of the



Fig. 20. Dissemination by blood stream. The small vessels contain groups of cancer cells. Case of mammary carcinoma. (X 160).



Fig 21 Section of acini showing small group of malignant cells in the lumen of an acinus ( $\times 160$ )



Fig 22 Duct papilloma the structure being of the radicular type ( $\times 60$ )

method employed An outline diagram of each breast as shown in whole section has been made each section was then carefully traversed with the microscope, and each point of lymphatic spread was noted and allotted to its appropriate place on the corresponding chart The results have been of interest

Let us assume that a focus of malignant disease has originated in a breast Lymphatic invasion is an early sequel but in such an early case as we have visualized the conveyance of the malignant cells by the lymphatics is in a constant direction and that is vertically through the thickness of the breast,

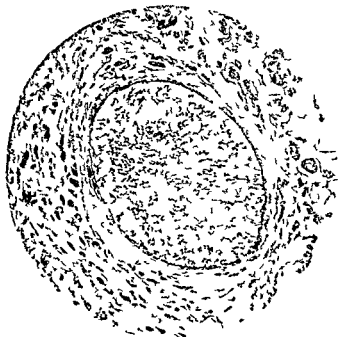


Fig 23 Hyperplasia of duct epithelium secondary to a focus of malignant disease ( $\times 60$ )

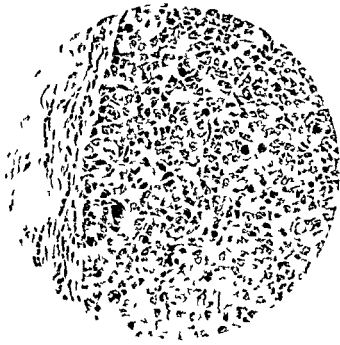


Fig 24 (right) Section illustrating the type of cell resulting from duct epithelium hyperplasia Note the large cell the large nucleus the active mitosis and the tendency to vacuolation ( $\times 300$ )

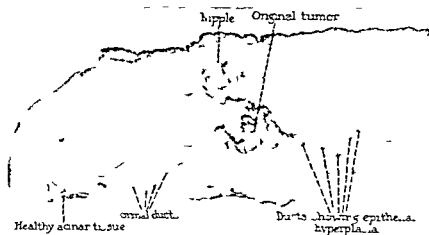


Fig. 25. To illustrate the extension of the duct hyperplasia from the original tumor

particularly in the center of the organ and to the retromammary prepectoral fascia whence the distribution is in a centrifugal direction. In whatever portion of the breast the primary tumor may originate this scheme of primary central vertical lymphatic distribution is apparent.

Having gained entrance to the lymph stream tumor cells evidently multiply with rapidity so that in a short space of time the main central lymphatics become filled and effectually plugged with them. Under these conditions the obstruction which now exists to the normal lymph flow results in an opening up of a number of subsidiary channels which though hitherto minute in size have existed throughout the breast tissue and particularly in the periductal and peri-acinar tissues. Quantities of minute cancer cell groups enter these enlarging subsidiary channels and so a widespread and general lymphatic distribution arises throughout the breast. From what we have observed the more general invasion is always secondary to the invasion of the central lymphatics and their occlusion by growing cancer plugs.

We have been particularly interested to observe what part (if any) the subcutaneous lymphatic system plays in the dissemination of the disease. As far as our experience has gone we have been unable to detect any lymphatic spread in this area. Even in tumors of such an extent and so superficial

that considerable areas of skin were involved in ulceration there was no evidence of a subcutaneous or cutaneous lymphatic dissemination. In certain specimens there has been evidence of dilatation of lymphatic vessels in the subcutaneous tissues and it seems reasonable to assume that the dilatation has been in response to the closure of the deeper lymphatics and it is possible that at a late stage of the disease these accessory lymphatics become the medium of a lymphatic spread but in that event the process is a late one and evidently an unusual one; there was at least no evidence of its occurrence in a series of fifty breasts representing all degrees of malignant invasion.

The cases which demonstrated the dilatation of the subcutaneous lymphatics were associated clinically with that pachydermatous condition of the skin which in many textbooks is spoken of as cancer *en cuirasse* but that the term so used is a misnomer was abundantly clear for there was no cancerous infiltration only a subcutaneous lymphatic engorgement and an edema of the papillary structures of the skin.

To summarize a study of lymphatic dissemination by the method of plotting the sites of infection suggests that the early lymphatic spread is through a central group of vessels which penetrate vertically through the breast center on to the retromammary fascia. Occlusion of the vessels follows as

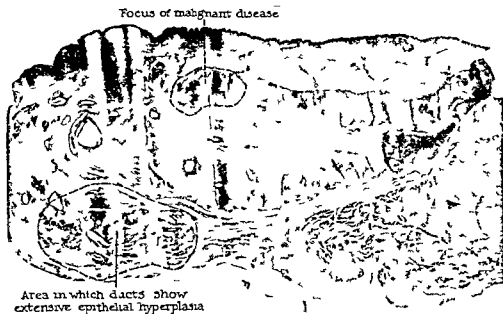


Fig 26 The development of duct epithelium hyperplasia adjacent to focus of malignant disease

the intramural deposits grow, and the derangement of the lymph flow which results is evidenced in the opening of numerous secondary channels hitherto potential rather than active. These channels enlarge and thereafter become the site of a widespread lymphatic dissemination throughout the breast tissue. At a later phase of the disease the lymphatic involvement may be so great that the lymph stream is diverted through the subcutaneous groups, which in their turn dilate, yet which curiously enough rarely become the site of a further dissemination of the disease. In cases of so called "cancer en cuirasse" a subcutaneous and cutaneous lymphatic engorgement is the distinctive pathological feature, there is no evidence of infiltration by malignant cells.

No discussion of the mammary lymphatics and the part they play in cancer dissemination would be complete without reference to Sampson Handley's work. He believes that "cancer spreads on the parietal tissues by permeating the lymphatic system like an invisible annular ringworm. The growing edge extends like a ripple in a wider and wider circle, within the circumference of which healing processes take place, so that the ring of permeation at any one time is not a disc but a ring." I have quoted Handley's

words, as they summarize his views on the dissemination of the disease, and our researches agree with the view which he and others have expressed, that dissemination extends by the lymphatics which are to be found throughout the deep submammary fascia, but we are unable to confirm his account of an annular dissemination by lymphatic permeation. In contrast to his experience, we have found the heaviest involvement of the lymphatics in the immediate proximity of the original growth, and this applies to all types of disease, early or advanced. Moreover there has been no evidence of the fibrosis and destruction of cancer cells by which Handley explained the freedom of the immediate vicinity of the tumor from lymphatic cancer deposits. More than this we cannot say, as our research has not included examination of the tissues beyond the confines of the breast.

The impression which these sections have given is that the lymphatic invasion and extension are on an embolic basis rather than on the permeative principle which Handley has described, there was repeated evidence that the intralymphatic cells were items in an active circulation. It has seemed to us that these observations cannot be reconciled with a purely permeative explanation of cancer formation.



Fig. 21. Transmigration of complete breast into malignant tissue tumor originating from duct epithelium.

*C Dissemination by the blood stream* The answer to the question Does the blood stream act as a medium for the dissemination of disease in carcinoma of the breast? is best given by reference to Figure 20. Here there is apparent beyond any possibility of doubt a cluster of malignant cells within the lumen of the blood vessel. I think there can be no criticism of the accuracy of the anatomical situation. The cells are also in a state of active division so that the stage may be said to be set for an active blood dissemination of the disease. Whether emboli of this nature are capable of producing metastatic foci of disease or whether as Schmidt<sup>1</sup> suggests they are destroyed by organization of the encasing thrombus cannot be stated from the evidence which we possess. At the most it can only be said that the illustration demonstrates the occurrence of cancerous blood emboli in cases of mammary carcinoma.

*D Dissemination by the duct system* Previous to this investigation we had not sufficiently realized the part which the duct canal system may play in the dissemination of the disease. When one gives the matter thought it seems reasonable to suppose that if tumor cells gain access to the free surface of the duct system they may eventually be distributed over widely separated parts of the interior and yet I cannot recollect any statement in

the literature of the subject which brings out this point with the distinction which it deserves. Again I use an illustration as the evidence upon which the statement is based. Figure 21 is a microphotograph showing the outline of a breast acinus. Lying free in the lumen are several spheroidal-shaped cells which can be distinguished from the lining epithelium of the acinus. The shape is that of an irregular spheroid with variation in size. The staining reaction is characterized by the eosinophilic response of the cell body; the nuclei show hyperchromatism and mitosis—a group of features which indicates the malignant character of the cells and their distinction from the healthy acinar tissue. It is evident that these cells have been borne by the fluid which bathes the ducts and the acini that they have been carried from some distant focus into the recess of this acinus where doubtless they will form the nucleus from which a fresh outbreak of disease will develop. As a matter of fact in this instance the primary focus was situated in a segment of the breast far distant from that in which the acinar deposit existed.

It is clear that this method of dissemination is most likely to take place when the original tumor is one growing from the free surface of a duct but as we shall presently attempt to show duct epithelium changes of a malignant nature are such a frequent accompani-



Fig 28 Hyperplasia of duct epithelium. A chain of cells is invading the periductal tissue as a malignant infiltration ( $\times 140$ )



Fig 29 Hyperplasia of the duct epithelium with malignant infiltration of the surrounding tissues and the periductal lymphatics ( $\times 60$ )

ment of breast carcinoma that the existence of this source must constantly be reckoned on. The methods by which the duct dissemination is produced are probably varied: the pressure of garments, handling the breast in the course of examination, even the contraction of the non-striped muscle which is incorporated in the breast.

#### THE ASSOCIATED PHENOMENA OF BREAST CARCINOMA

If anything was required to justify the investigation of breast tumors by the whole section method, it will be found in the evidence obtained regarding the changes which develop in a breast in association with the appearance of an original and isolated focus of malignant disease. It would seem that many of us assume that the pathological picture is a localized one, spreading, it may be, as the disease extends, yet developing within the limits of the continuity and the permeation of the multiplying malignant cells. The picture, however, is really a very different one. In the average case of breast carcinoma, what we may consider to be the original focus of disease is only one of a wide spread series of changes. In fact, after study

ing the perspective, one may be inclined to be cautious in one's use of the term "original" as applied to a peculiar section of the tumor, for it is difficult to place the sequence of pathological events in their proper order.



Fig 30 A single duct epithelium cell has passed into the periductal tissues. Note the intense cell infiltration which its presence has induced ( $\times 160$ )





Fig 31. Mastitis carcinoma. Tumor arising from duct epithelioma. There is a widespread hyperplasia of the duct epithelium and the extensive tumor infiltration has resulted from a malignant change of the hyperplastic epithelium.

Neglecting for a moment however this more debatable aspect let us consider the more important of the associated changes grouping them as A duct changes and B, acinar changes.

**A Duct changes** Cheatele has recently published a series of papers dealing with certain epithelial hyperplasias of the duct lining epithelium and having studied these various contributions it was interesting to observe what whole breast sections revealed of the occurrence and of the distribution of such hyperplastic changes.

It is we believe a correct appreciation to recognize two types of duct epithelial hyperplasia (1) that which is radicular in structure provided with a vascular stem along which the blood supply is distributed a type in which the lining epithelium while greatly increased in surface extent is not unreasonably exaggerated in thickness (this is the variety in fact which forms the intraductal and intracystic varieties of papilloma simple or malignant) and (2) the non radicular type characterized by a proliferation of epithelial cells without any evident sign of supporting structure a process by virtue of which large extents of duct area become filled with syncytial like masses of proliferated epithelium.

It is evident that any association which may exist between the duct epithelium proliferation and an independent malignant focus affects only the second of these varieties and we would add that from what we have seen in whole breast sections, we believe the association to be a very close and important one.

The situation is thus that in every malignant breast which we investigated changes were apparent in the duct epithelium. After a study of these changes and their distribution we felt justified in arriving at certain conclusions.

a *The changes are not those of an ordinary catarrhal process*—This was made clear by at least two features. The cells at first small and cubical eventually became large in outline polyhedral in shape with a protoplasm which is clear in substance and occasionally vacuolated further there is no evidence of the leucocytic infiltration which accompanies a catarrhal process.

b *The changes originate in proximity to a malignant focus and extend centrifugally from this center*. This is made evident by charting the distribution of the duct change in a series of specimens. The feature is at first an isolated one but it spreads and extends until in some specimens it will be found to involve the entire duct system of the mamma.



Fig 32 The acinar structure of a normal breast ( $\times 60$ )

c *The cells are malignant* While retained within the confines of the duct wall the cells proliferate and extend in the continuity of the canal the proliferation being often so intense that the central elements are deprived of nutrition and break down into central necrotic areas, the "Comedone" carcinoma of Bloodgood. At a later stage, however, and under conditions which at present it is difficult to assess, the cells migrate from the intraductal space and pass into the periductal tissues. Here they assume the characters of true malignant cells, the shape alters in so far as they become smaller, probably as the result of a pressure to which previously they had not been subjected, they coincidentally lose their clear and vacuolated appearance (probably for a similar reason), they infiltrate the surrounding tissues, they pass into the lymphatics which are so numerous in the periductal spaces and so they are distributed as malignant cells throughout the structure of the mamma.

A point of great interest is demonstrated in Figure 30. It is evident that these cells possess a property which exerts a harmful chemotactic influence upon lymphocytes, and this is manifest as soon as the cell or cells pass beyond the limiting tissues. In the illustration indicated a single cell has passed



Fig 33 The transformation of acinar epithelium into malignant cells the process arising secondary to a focus of malignant disease in the breast and coincident with a generalized hyperplasia of duct epithelium ( $\times 60$ )

through the duct wall, and its advent into the periductal tissues has been the signal for an intense surrounding accumulation of lymphocytic cells, a reaction which it is natural to assume has been in response to an irritative property of some description.

The relation of the duct epithelial change to the local focus of malignant disease is obscure. Is the duct epithelium hyperplasia a phenomenon which is reactionary to and dependent upon a stimulus produced by the already developed malignant focus, or is the duct change the original one, the cancer focus being a local malignancy in a more general and premalignant disturbance? Various points may be quoted for and against each of these views, and it is difficult to see how confirmation on either hand can be afforded. The impression we have received is that a local focus of malignancy first develops. A stimulus which has either acted in the production of the original forms or has arisen secondary to it is afterwards carried probably in a secretion along the duct surface, affecting the epithelium as it passes and inducing the characteristic hyperplasia, sometimes passing slowly and gradually, at other times extending freely and rapidly, so that the entire

breast duct system becomes involved. I accept on some such basis as this it is difficult to see how one can explain the centrifugal extension of this duct change an extension which is abundantly evident in many specimens.

The significance of duct epithelium changes secondary to a localized malignant focus has been one of the most striking features revealed in whole section examination. We have realized as never before how widespread are these potentially malignant changes and the realization has altered our whole conception of the pathology of malignant disease. Cells far distant from the original focus and wide spread in their distribution are subjected to a stimulus which converts the innocent cell of healthy function and natural growth into a tissue erotic in its growth and malignant in its characters. Further it is impossible to overlook the significance of the fact that the responding element is a surface epithelium and therefore subject to a fluid borne or secretion stimulus.

**B Acinar changes.** Reactionary changes in the acinar epithelium are as striking as those met with in the ducts. I show you in succession two sections one illustrating the acinar structures of the healthy breast of a woman of 35 years of age and in contrast to it a section of acinar tissue from the breast of a woman of similar age (35) but in this instance the breast was the site of a focus of cancer. The section illustrated was removed from a portion of the breast distant from the original tumor by a considerable area and moreover it was from a segment which showed no naked eye evidence of disease. The tissues are shown in a corresponding magnification (60 diameters) in order to demonstrate how striking are the distinctions and it is apparent that the acini related to the malignant breast are undergoing a change by which the lining epithelium is being converted into cells endowed with the characteristics of malignancy. The cells have proliferated so as to distend the acini; they are of the large nucleated clear protoplasm type; the nuclei show hyperchromatosis and irregular mitosis; in places the acinar basement membrane is invaded and the cells have

passed into the surrounding tissues where they have behaved after the manner of malignant cells.

The picture is very similar to that described in relation to the duct changes and the inference which we draw is similar that the acinar cell change is a response to a stimulus carried throughout the ducto-acinar system probably through the medium of a secretion.

There are various modifications of the process it may be that the altered acinar cells are not of the large clear type but of a small round celled type but the process remains the same—the conversion of acinar epithelium into a tissue with the characters of the fully malignant type a change which may be widespread throughout the mamma.

#### SUMMARY

1. Whole sections of the breast afford an excellent opportunity of studying the complete mammary picture of breast carcinoma.

2. Studies of the virginal marital and senile breasts demonstrate the activity of the acinar epithelium the epithelium which lines the cul de sacs of the terminal ducts.

3. The activities of proliferation and retrogression of the acinar epithelium are related to the arrangement of the elastica for in the breast which is physiologically active the elastica does not enclose the duct terminations while in the senile breast it extends so as to seal up the duct termination.

4. The classification of malignant breast tumors is unsatisfactory and the difficulty is increased because several different types of tumor may occur in one breast.

5. Lymphatic dissemination of malignant tumor is by a vertical group of central lymphatics which extend centrifugally in the deep fascia later intramammary lymphatics open up. There is no evidence that the subcutaneous lymphatics play a part in the dissemination.

6. Other sources of dissemination are the blood vessels and the duct system.

7. A localized malignant tumor is associated with widespread secondary changes in the duct and in the acinar system these taking the form of an epithelial proliferation which ultimately becomes malignant.

PERITONITIS, AN EXPERIMENTAL STUDY<sup>1</sup>

BY VERNON C. DAVID, M.D., CHICAGO

IN a critical review of 11,000 cases of general suppurative peritonitis occurring in the leading German clinics during the last 30 years Kirschner (10) shows that the general mortality has fallen enormously. Considering all causes it has dropped from 87.5 per cent in 1895 to 30 per cent in 1925. In general peritonitis following appendicitis the mortality has fallen from 85 per cent in 1895 to 20 per cent in 1924. A corresponding decrease in mortality in general peritonitis from practically all causes has occurred except in postoperative peritonitis in which the mortality is still very high. These figures in a general way correspond to the improved mortality statistics found in reports from our own country and England.

This marked reduction in the mortality rate of general peritonitis is in most part due to early diagnosis, early speedy and non-traumatic operation which aims to eliminate the source of the infection, establishment of drainage when necessary and proper after treatment which includes in this country, Fowler's position and maintenance of fluid balance, stomach lavage and in certain instances the establishment of an ileostomy.

While improvement in diagnosis and technique may still lower the mortality, it seems probable that a further decrease in the death rate will be intimately concerned with a better understanding of the physiological and pathological processes involved in general peritonitis. These problems are extremely complex and involve many phenomena not well understood. That we are dealing with an infection of a cavity the surface of which equals that of the cutaneous surface of the body makes it evident that the questions of toxæmia and septicæmia are always in the fore in estimating the causes that lead to a fatal termination.

The absorption of bacteria and toxins from the peritoneum with subsequent damage to the vasomotor apparatus and the possible effect on the production of paralytic ileus may be weighed against the local effect of the

bacteria and their toxins on the bowel with the establishment of a paralytic ileus, portal stasis and circulatory failure. Many other complex problems present themselves. In general these problems may be listed as to the question of absorption of bacteria and toxins from the peritoneal cavity, the problem of the production of paralytic ileus and its influence on mortality and finally the questions involved in the early circulatory failure so often observed in general peritonitis. Some light may be thrown on the general picture by a study of isolated problems that go to make up the whole.

The object of this communication is to review the work done on the problem of absorption from the peritoneal cavity, and to present some experiments bearing on the subject of the passage of bacillus coli from the peritoneum. These experiments may indicate by analogy some of the processes which take place in general peritonitis.

## ABSORPTION OF FLUIDS FROM THE PERITONEUM

In a study of the absorption of fluid from serous cavities Dybrowsky (7) in 1866 observed that there was an interchange of fluids between the blood stream and fluid in the pleural cavity whereas solid particles were largely taken up in the lymph spaces. Magendie (14) observed that absorption of fluids from the pleura was more rapid if the volume of circulating blood had been diminished. From an experimental study on the absorption of fluid from the intestine Heidenhain (9) believed that vital characteristics of the cells influenced absorption of fluids into the blood stream. Following this work one of the most fundamental experimental studies was made by Starling, Tubby, Matthes and Leathes (12, 16 and 21). They found that the absorption of fluids from the pleura and peritoneum obeyed almost entirely the laws of osmosis and that it was not necessary to assume a vital character of the cells. Hypertonic solutions in the peritoneum increase in amount by

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absorption of fluid from the blood until the intraperitoneal solution becomes isotonic when slow absorption takes place. Hypotonic solutions on the other hand are rapidly absorbed into the blood stream. Isotonic solutions vary in the rapidity of their absorption, some being rather rapidly absorbed at first with a marked secondary slowing of absorption while others as normal blood serum are absorbed very slowly and may be taken up by the lymphatics. To a lesser degree after the death of an animal the absorption of fluid solutions from the peritoneum obey the laws of osmosis (LePlav and Max 13).

Clairmont and Haberer (4) studied the absorption of sugar and potassium iodide from the peritoneum into the blood stream and their appearance in the urine. Driving of the intestines by evisceration retarded the absorption. Increase of peristalsis increased the rate of absorption. Prima (20) substantiated this observation finding that the absorption was increased one fourth to one half and that no difference was observed between mechanical or chemical stimuli in increasing peristalsis. He also showed experimentally that opening the abdomen decreased the absorptive power of the peritoneum. Clairmont and Haberer irritated the peritoneum with croton oil, turpentine, stomach contents and bile and found the rate of absorption of potassium iodide from such a peritoneum greatly increased. In a fully developed peritonitis the rate of absorption was definitely slowed. If hypertonic glucose was injected into the peritoneum the absorption of potassium iodide was not slowed. These authors attempted to exclude the diaphragm as an absorptive area by painting it with collodion and found under such conditions that the secretion of potassium iodide in the urine was much delayed.

Achard and Gaillard (1) have shown that the higher the molecular weight of organic materials in the peritoneum the lower will be the rate of absorption into the blood. Danielsen (6) concluded as the result of experimental work that crystalloids are absorbed from the peritoneum through the blood stream and that colloid substances are absorbed from the lymph spaces. Fleisher and Loeb (8) performed nephrectomy or ligated the

renal vessels and found an increased osmotic pressure of the blood and an increased rate of absorption from the peritoneum. They found no direct relation between diuresis and absorption from the peritoneal cavity. Pertinent to these observations Starling points out that the osmotic pressure of blood proteins is related to the absorption of fluid by blood vessels in that increasing protein concentration of a peritoneal saline solution reduces the absorbing force to the hydrostatic pressure in the capillaries when absorption ceases.

Bolton (2) concluded from his work that colloidal dyes, indiffusible outside of the body, pass through the peritoneum and capillary wall by diffusion directly into the blood but slower than crystalloids. Colloids of a large molecular weight pass through much slower and it is probable that albuminous molecules are unable to do so. Klein (11) states that toxins of low concentration are absorbed rapidly from the peritoneum and that conversely toxins of high molecular weight are absorbed very slowly into the blood.

#### PASSAGE OF SOLID PARTICLES FROM THE PERITONEUM

It has been known that solid particles are taken up by the lymphatics in the peritoneum and are either carried to the retroperitoneal glands, or through the diaphragmatic lymphatics to the mediastinal glands and into the thoracic duct or are absorbed in the lymphatics emptying directly into the thoracic duct. It was at first supposed that this absorption took place through stomata between the endothelial cells of the peritoneum, but Muscatello (17) demonstrated that the so-called stomata were artefacts. McCallum (13) contends that the endothelial surface of the peritoneum is continuous and that particles passing through it are taken up by phagocytes which property may be shown by lymph cell or the endothelial cells of the peritoneum. The mechanical effect of respiration has a great influence on the passage of particular matter through the peritoneum and this may be demonstrated by establishing artificial respiration in a recently killed animal.

Cunningham (5) injected lamp-black intraperitoneally in cats. In 3 minutes it could be

demonstrated in the mediastinal glands. In 5 to 10 minutes some phagocytosis had taken place *in situ*. Evidence was presented to show that the particles were passing through the cytoplasm of the lymph cells and not between the cells.

Bolton injected silver nitrate solution into the peritoneal cavity of cats and found that it passed exclusively through the lymphatics, and that the force of respiration greatly increased the rate of absorption.

#### PASSAGE OF MICRO ORGANISMS THROUGH THE PERITONEUM

Thiele and Imbleton (22) injected micro organisms into the peritoneal cavity and found that they appeared in the thoracic duct chyle in 2 to 10 minutes. If the thoracic duct had been previously tied, no organisms were found in the blood stream.

Peiser (19) injected bacteria into the peritoneum and describes their rapid appearance in the blood stream, followed by a period when only a few bacteria were found. Salt solution injected with the bacteria or irrigation of the peritoneal cavity with normal salt solution, favors the rapidity of their absorption. He was unable to show changes in absorption which were influenced by posture of the body, as for example, in Fowler's position.

Danielsen found that bacteria injected into the peritoneum appeared in the chyle but were not present in the blood stream if the thoracic duct had been divided. Buxton (3) found that typhoid bacilli injected into the peritoneum appeared in the blood quickly and were present in largest number 5 to 15 minutes after their injection, but were still present in the blood in decreasing numbers after an hour. Wells and Johnstone (24) conducted experiments in which bacillus coli and streptococci were injected into the peritoneal cavity. They found great quantities of micro organisms in the thoracic duct after 15 minutes, but in decreasing numbers in an hour. Blood cultures were practically all sterile even though the thoracic duct was untouched, showing, in Wells' and Johnstone's opinion, that the bacteria used did not live in the blood stream. They felt that proof had not been advanced that bacteria were absorbed directly

into the blood stream from the peritoneal cavity. Fwort (23), in similar experiments found the bacteria in the anterior thoracic glands and occasionally in pleural fluid. The submaxillary and submental glands remained sterile. Injection of oil into the peritoneum 15 to 30 minutes before injection of the bacteria made no difference in the results.

#### EXPERIMENTS

Our experiments are concerned with the passage of bacillus coli from the normal peritoneum, from the peritoneum which is undergoing different grades of peritonitis, and from the peritoneum which contains a transudate.

Healthy adult dogs of medium size which had been fed on a fat diet were used.

*Passage of bacillus coli from the normal peritoneum.* The questions involved are whether the bacillus coli injected intraperitoneally is taken up by the lymphatics alone, or whether it passes directly into the blood stream as well.

*Experiment I.* The thoracic duct was exposed in the neck and divided. The femoral artery was exposed and divided, the distal end ligated and the proximal end closed with a vessel clamp so that blood could be obtained for culture. Control cultures of 1 cubic centimeter of chyle and 5 cubic centimeters of blood were sterile. Twenty cubic centimeters of a bouillon culture of bacillus coli were injected intraperitoneally through a trocar inserted midway between the symphysis and ensiform.

Bacillus coli injected at 10 10

Chyle	Blood
10 14 sterile	10 15 sterile
10 18 1 colony	10 22 1 colony
10 21 many colonies	10 29 12 colonies
10 27 many colonies	10 36 5 colonies
10 29 8 colonies	10 39 2 colonies
10 32 many colonies	10 48 sterile
10 34 43 colonies	10 56 sterile
10 41 1 colony	
10 55 14 colonies	

This experiment and others giving substantially the same results show that the bacillus coli is taken into the blood stream directly, as well as into the lymphatic system, unless lymphatic channels are present on the left side of the neck which allow the bacillus coli to gain entrance into the blood through them. To establish conditions that would decide this point not only was the thoracic duct divided

on the left side, but the subclavian, innominate internal and external jugular veins were ligated on both sides of the neck in 3 dogs. Experiment I was repeated with the same results showing that the presence of colon bacilli in the blood stream was not due to their entry through lymphatics in either the right or left side of the neck.

The question as to whether the bacillus coli was first taken up by the portal circulation and then gained access to the general circulation was next considered.

*Experiment 2* Part of the right lobe of the liver in a medium sized dog was extraperitonealized by drawing it outside of the abdomen through a right rectus incision and sewing the peritoneum around it so that it lay on the anterior abdominal wall. The remaining layers of abdomen were closed around it. The thoracic duct was divided and the femoral artery was prepared as in Experiment I. Control cultures of 3 cubic centimeters of femoral arterial blood, 2 cubic centimeters of liver blood obtained by shaving off a piece of liver and a pirating the blood into a sterile pipette and 1 cubic centimeter of chyle from the thoracic duct were sterile. Twenty cubic centimeters of a 24 hour bouillon culture of bacillus coli were injected intraperitoneally as in Experiment I.

Bacillus coli injected at 10 50	
Chyle	Blood
10 55 sterile	10 57 sterile
11 02 countless	
11 02 countless colonies	11 03 20 colonies
11 07 countless colonies	11 10 60 colonies
11 10 countless colonies	11 21 15 colonies
11 25 countless colonies	11 29 35 colonies
11 46 countless colonies	11 48 40 colonies
11 52 many but fewer	
12 03 16 colonies	

Liver blood	
10 57 sterile	
11 02 12 colonies	
11 08 25 colonies	
11 0 4 colonies	
11 27 2 colonies	
11 43 10 colonies	
11 54 1 colony	
12 08 4 colonies	

This same experiment was repeated pieces of liver being taken which were ground and cultured. Two to four colonies of bacillus coli were obtained from each cube of liver tissue which was about three fourths of an inch square.

The same experiment was repeated except that the spleen was extraperitonealized. The

blood from the spleen showed 1 to 3 colonies of bacillus coli in 2 to 3 cubic centimeters of blood to 8 to 40 colonies obtained from 5 cubic centimeters of femoral arterial blood. The time of appearance of bacillus coli in the blood of the liver and the spleen was about the same as the time of its appearance in the femoral blood.

These experiments in which bacillus coli was injected intraperitoneally and subsequently appeared in the chyle, peripheral blood stream, liver and spleen, demonstrate that

1 The bacillus coli appeared in the chyle from the thoracic duct in 5 to 12 minutes the maximum number occurring from 30 to 45 minutes after its intraperitoneal injection when it began to decrease in numbers.

2 Bacillus coli appeared in the peripheral blood in 12 to 18 minutes reaching a maximum in about 20 minutes after which it tended to decrease in number.

3 Bacillus coli appeared in the liver tissue and blood from the liver and spleen at about the same time the micro-organisms appeared in the general blood stream. There appeared to be more micro organisms in the peripheral blood stream than in the liver or spleen.

4 Evidence is presented that bacillus coli is taken up directly into the blood stream from the peritoneum as well as directly into the lymphatics. It appeared earlier in the chyle and in greater numbers per unit of measurement.

5 After the first rapid appearance of the micro-organisms in the blood and chyle they seemed to decrease in numbers.

*Passage of bacillus coli from the inflamed peritoneum* The next question investigated was whether peritonitis would influence the passage of bacillus coli from the peritoneum. In order to establish different grades of non infectious peritonitis varying from a hyperæmia to a well developed plastic exudate we used intraperitoneal injections of turpentine emulsion. After the turpentine injections barbital was given hypodermically to keep the animal comfortable. The results of these intraperitoneal injections of turpentine were as follows:

1 Twenty cubic centimeters of a 50 per cent turpentine emulsion injected intraperi-

tionally caused a fatal plastic peritonitis with marked hyperæmia of the visceral and parietal peritoneum accumulation of the intestinal loops and from 200 to 300 cubic centimeters of bloody fluid in the peritoneal cavity. Paralytic ileus was not observed in any experiment.

2 Ten cubic centimeters of a 5 per cent turpentine emulsion injected intraperitoneally in both the upper and lower abdomen usually caused a marked plastic peritonitis in 24 hours which was usually nonfatal though the animal became apathetic and sick.

3 Ten cubic centimeters of a 5 per cent turpentine emulsion injected intraperitoneally 7 days and 1 day before the postmortem usually caused a hyperæmic peritoneum with some bloody fluid and a slight plastic exudate.

4 Ten cubic centimeters of a 5 per cent turpentine emulsion injected intraperitoneally one week before the postmortem usually showed but a slight hyperæmia of the peritoneum.

The passage of bacillus coli into the lymphatics and blood stream from the peritoneum which was the seat of an inflammatory process was next studied.

*Experiment 3* Forty eight and twenty four hours before the experiment 10 cubic centimeters of a 5 per cent turpentine emulsion were injected into the upper and lower peritoneum. On the morning of the experiment a small laparotomy incision was made and a trocar was inserted between intestinal loops. The abdominal wall was tightly closed in layers around the trocar. The thoracic duct was divided and the femoral artery was exposed as already described. Control chyle and femoral arterial blood were sterile. Twenty cubic centimeters of a 24 hour bouillon culture of bacillus coli were injected through the trocar into the peritoneum.

Bacillus coli injected at 10 27

Chyle	Blood
10 31 sterile	10 33 sterile
10 37 sterile	10 35 sterile
10 44 sterile	10 46 sterile
10 52 sterile	10 52 sterile
10 57 sterile	10 59 sterile

At postmortem there was a marked plastic peritonitis with 300 cubic centimeters of bloody fluid in the peritoneal cavity. Culture of this fluid showed a rich growth of bacillus coli. The parietal and visceral peritoneum was hyperæmic and covered with thick plaques of fibrin.

Chyle	Blood
10 10 sterile	10 11 sterile
10 11 two colonies	10 17 sterile
10 21 many colonies	10 18 sterile
10 27 many colonies	10 28 sterile
10 31 many colonies	10 37 sterile
10 32 many colonies	10 51 sterile
10 50 many colonies	11 00 sterile
10 59 diminishing number	
11 01 diminishing number	

Postmortem showed 100 cubic centimeters of bloody peritoneal fluid and very slight fibrinous exudate.

*Experiment 5* In three dogs having a hyperæmia of the peritoneum, but with no fluid or fibrous exudate, the passage of bacillus coli from the peritoneum was studied. The blood remained sterile in all 3 animals following the intraperitoneal injection of bacillus coli, but in 2 of the animals the chyle contained the usual number of bacilli coli. In the remaining animal both blood and chyle were sterile. The details of only one experiment will be given.

Four days and one day before the experiment the dog received 10 cubic centimeters of 5 per cent turpentine emulsion intraperitoneally. Through a small laparotomy wound the end of a trocar was inserted into the depth of the cul de sac of Douglas. The abdomen was closed tightly in layers around the trocar. The thoracic duct was divided and the femoral artery was exposed as in former experiments. A control culture of chyle and blood was sterile. Twenty cubic centimeters of a 24 hour bouillon cul-



ture of bacillus coli were injected through the trocar into the peritoneum

Bacillus coli injected at 10 26

Chyle	Blood
10 20 sterile	10 31 sterile
10 34 3 colonies	10 42 sterile
10 40 sterile	10 46 sterile
10 52 sterile	10 52 sterile
11 01 many colonies	11 04 sterile
11 07 many colonies	11 10 sterile
11 17 many colonies	11 20 sterile
11 22 2 colonies	11 22 sterile

At postmortem the peritoneum showed a slight hyperæmia but no bloody fluid or plastic exudate

We may conclude from these experiments that

1 In a well developed plastic peritonitis with bloody peritoneal fluid caused by the injection of turpentine into the peritoneum of dogs the passage of colon bacilli into the lymphatics or blood stream is practically nil

2 Where the peritonitis is chiefly shown by hyperæmia and bloody intraperitoneal fluid with a slight amount of plastic exudate the colon bacilli are usually taken into the chyle through the lymphatics but the blood remains sterile when the thoracic duct has been divided

3 When only hyperæmia without gross exudate in the peritoneum is present following the intraperitoneal injection of turpentine colon bacilli are usually taken into the chyle through the lymphatics but the blood is sterile when the thoracic duct has been divided

4 All of the factors present in these experimental types of peritonitis which prevent the passage of bacillus coli into the blood stream or into the lymphatics in severe plastic peritonitis are not known but the most important one to consider is the injury to the peritoneum and blood vessels by an inflammatory agent which produces hyperæmia sero-sanguinous and plastic exudate These products of inflammation are identical to those found in bacterial peritonitis It may be fair to assume by analogy therefore that the frequent fatal outcome in general peritonitis with plastic exudate is not due to the passage of micro organisms from the peritoneum through the lymphatics or directly into the blood stream

The last problem studied concerns the influence of a peritoneal transudate on the passage of bacillus coli from the peritoneum

It has been suggested by several investigators that general peritonitis should be treated by the intraperitoneal injection of hypertonic glucose solution on the principle advanced by Wright in the treatment of infected wounds by hypertonic solutions with a consequent lymph lavage Narat (18) reported unusual benefit in the treatment of experimental peritonitis by the intraperitoneal injection of hypertonic glucose solution As has been stated Starling and his associates established the fact that the laws of osmosis govern the interchange between intraperitoneal hypertonic solution and the blood The increase in volume of a hypertonic solution in the peritoneal cavity continues until the hypertonic solution becomes isotonic when it is slowly absorbed These facts have been corroborated by many observers Narat says that a rabbit can tolerate 1/50 of its body weight of 20 per cent glucose solution which in an hour has increased its volume to 83 cubic centimeters and in 3 hours to 110 cubic centimeters

In estimating what amount of hypertonic glucose solution a dog could tolerate intraperitoneally we gave 2 dogs intraperitoneally 200 grams of glucose dissolved in 240 cubic centimeters of water They both died the same day with muscular twitchings frothy mucus in the lungs and throat, and concentrated urine which contained sugar, blood and albumin The intestines were contracted and contained bloody mucus The peritoneum was hyperæmic and contained 775 and 1 000 cubic centimeters respectively of blood stained fluid the sugar content of which was 8 per cent and 4 3 per cent respectively The blood sugar was 666 and 482 respectively

On further investigation we found that a medium sized dog would stand the intraperitoneal injection of 50 grams of glucose dissolved in 90 cubic centimeters of fluid One hundred grams of glucose dissolved in 125 cubic centimeters of fluid given intraperitoneally would not kill the dog if after injection intravenous isotonic salt or glucose solution were given or if the dog drank large quantities of water

*Experiment 6* A medium sized dog was given 25 cubic centimeters of 50 per cent glucose solution

intraperitoneally 12 hours before the experiment. The thoracic duct was divided and the femoral artery exposed. Control chyle and femoral arterial blood each contained one colony, which was not bacillus coli. Twenty cubic centimeters of 24 hour bouillon culture of bacillus coli were injected intraperitoneally.

Bacillus coli injected at 11 44	
Chyle	Blood
11 51 sterile	11 56 9 colonies
11 53 sterile	11 57 1 colony
11 57 sterile	11 59 400 colonies
12 03 128 colonies	12 05 800 colonies
12 10 960 colonies	12 14 1920 colonies
12 20 2240 colonies	12 22 countless
12 30 countless	12 32 countless

Postmortem examination showed a hyperæmia of the parietal and visceral peritoneum with 300 cubic centimeters of bloody fluid in the peritoneal cavity.

Two other dogs were studied in the same way with the same result, each animal giving a very abundant growth of bacillus coli from the divided thoracic duct and from the peripheral blood stream. To the end of the experiment, 45 minutes after the intraperitoneal injection of bacillus coli, there was no tendency for the micro organisms to diminish in number in either the chyle or in the blood.

We may conclude from these experiments that the bacillus coli injected into the peritoneum, which contains a transudate formed by the previous injection of hypertonic glucose solution, passes rapidly into the lymphatics and into the blood stream. The number of organisms appearing in the thoracic duct and blood under these conditions is much greater than that found from the normal peritoneum. Whatever benefit hypertonic glucose solution may have in the treatment of peritonitis, it is probably not due to the inhibition of the passage of micro organisms into the blood and thoracic duct lymph.

### CONCLUSIONS

1 Evidence is presented that colon bacilli pass directly into the blood stream as well as into the lymphatics from the normal peritoneum.

2 A well developed plastic peritonitis prevents the passage of bacillus coli from the peritoneum into the blood stream or into the lymphatics emptying into the thoracic duct.

3 Lesser grades of peritonitis prevent the passage of bacillus coli into the blood stream but usually do not prevent its passage into the lymphatics.

4 Colon bacilli, injected into the peritoneum which contains a transudate, pass rapidly and in great numbers into the chyle from the thoracic duct and directly into the blood stream.

5 By analogy we may assume that in a well developed general infectious peritonitis bacteria do not pass directly into the blood stream or into the lymphatics draining into the thoracic duct, and that the major problem in peritonitis does not concern itself with the development of a septicæmia.

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ture of bacillus coli were injected through the trocar into the peritoneum

Bacillus coli injected at 10 26

Chyle	Blood
10 20 sterile	10 31 sterile
10 34 3 colonies	10 41 sterile
10 40 sterile	10 46 sterile
10 52 sterile	10 52 sterile
11 01 many colonies	11 04 sterile
11 07 many colonies	11 10 sterile
11 17 many colonies	11 20 sterile
11 2 colonies	11 22 sterile

At postmortem the peritoneum showed a slight hyperæmia but no bloody fluid or plastic exudate

We may conclude from these experiments that

1 In a well developed plastic peritonitis with bloody peritoneal fluid caused by the injection of turpentine into the peritoneum of dogs the passage of colon bacilli into the lymphatics or blood stream is practically nil

2 Where the peritonitis is chiefly shown by hyperæmia and bloody intraperitoneal fluid with a slight amount of plastic exudate the colon bacilli are usually taken into the chyle through the lymphatics but the blood remains sterile when the thoracic duct has been divided

3 When only hyperæmia without gross exudate in the peritoneum is present following the intraperitoneal injection of turpentine colon bacilli are usually taken into the chyle through the lymphatics but the blood is sterile when the thoracic duct has been divided

4 All of the factors present in these experimental types of peritonitis which prevent the passage of bacillus coli into the blood stream or into the lymphatics in severe plastic peritonitis are not known but the most important one to consider is the injury to the peritoneum and blood vessels by an inflammatory agent which produces hyperæmia sero sanguinous and plastic exudate. These products of inflammation are identical to those found in bacterial peritonitis. It may be fair to assume by analogy therefore that the frequent fatal outcome in general peritonitis with plastic exudate is not due to the passage of micro organisms from the peritoneum through the lymphatics or directly into the blood stream

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It has been suggested by several investigators that general peritonitis should be treated by the intraperitoneal injection of hypertonic glucose solution on the principle advanced by Wright in the treatment of infected wounds by hypertonic solutions with a consequent lymph lavage. Narat (18) reported unusual benefit in the treatment of experimental peritonitis by the intraperitoneal injection of hypertonic glucose solution. As has been stated Starling and his associates established the fact that the laws of osmosis govern the interchange between intraperitoneal hypertonic solution and the blood. The increase in volume of a hypertonic solution in the peritoneal cavity continues until the hypertonic solution becomes isotonic when it is slowly absorbed. These facts have been corroborated by many observers. Narat says that a rabbit can tolerate 1/50 of its body weight of 20 per cent glucose solution which in an hour has increased its volume to 83 cubic centimeters and in 3 hours to 110 cubic centimeters.

In estimating what amount of hypertonic glucose solution a dog could tolerate intraperitoneally we gave 2 dogs intraperitoneally 100 grams of glucose dissolved in 240 cubic centimeters of water. They both died the same day with muscular twitchings, frothy mucus in the lungs and throat, and concentrated urine which contained sugar, blood and albumin. The intestines were contracted and contained bloody mucus. The peritoneum was hyperemic and contained 775 and 1,000 cubic centimeters respectively of blood stained fluid the sugar content of which was 8 per cent and 4.3 per cent respectively. The blood sugar was 666 and 582 respectively.

On further investigation we found that a medium sized dog would stand the intraperitoneal injection of 50 grams of glucose dissolved in 90 cubic centimeters of fluid. One hundred grams of glucose dissolved in 125 cubic centimeters of fluid given intraperitoneally would not kill the dog if after injection intravenous isotonic salt or glucose solution were given, or if the dog drank large quantities of water.

*Experiment 6* A medium sized dog was given 25 cubic centimeters of 50 per cent glucose solution



ture of bacillus coli were injected through the trocar into the peritoneum

Bacillus coli injected at 10 6

Chyle	Blood
10 0 sterile	10 31 sterile
10 34 3 colonies	10 42 sterile
10 40 sterile	10 46 sterile
10 52 sterile	10 52 sterile
11 01 many colonies	11 04 sterile
11 07 many colonies	11 10 sterile
11 17 many colonies	11 20 sterile
11 22 2 colonies	11 22 sterile

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3 When only hyperemia without gross exudate in the peritoneum is present following the intraperitoneal injection of turpentine colon bacilli are usually taken into the chyle through the lymphatics but the blood is sterile when the thoracic duct has been divided

4 All of the factors present in these experimental types of peritonitis which prevent the passage of bacillus coli into the blood stream or into the lymphatics in severe plastic peritonitis are not known but the most important one to consider is the injury to the peritoneum and blood vessels by an inflammatory agent which produces hyperemia sero sanguinous and plastic exudate These products of inflammation are identical to those found in bacterial peritonitis It may be fair to assume by analogy therefore that the frequent fatal outcome in general peritonitis with plastic exudate is not due to the passage of micro organisms from the peritoneum through the lymphatics or directly into the blood stream

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In estimating what amount of hypertonic glucose solution a dog could tolerate intraperitoneally we gave 2 dogs intraperitoneally, 200 grams of glucose dissolved in 240 cubic centimeters of water They both died the same day with muscular twitchings frothy mucus in the lungs and throat and concentrated urine which contained sugar blood and albumin The intestines were contracted and contained bloody mucus The peritoneum was hyperemic and contained 775 and 1,000 cubic centimeters respectively of blood stained fluid the sugar content of which was 8 per cent and 4.3 per cent respectively The blood sugar was 666 and 582 respectively

On further investigation we found that a medium sized dog would stand the intraperitoneal injection of 50 grams of glucose dissolved in 90 cubic centimeters of fluid One hundred grams of glucose dissolved in 125 cubic centimeters of fluid given intraperitoneally would not kill the dog if after injection intravenous isotonic salt or glucose solution were given or if the dog drank large quantities of water

Experiment 6 A medium sized dog was given 25 cubic centimeters of 50 per cent glucose solution

intraperitoneally 12 hours before the experiment. The thoracic duct was divided and the femoral artery exposed. Control chyle and femoral arterial blood each contained one colony which was no bacillus coli. Twenty cubic centimeters of 24 hour bouillon culture of bacillus coli were injected intraperitoneally.

Bacillus coli injected at 11:45	
Chyle	Blood
11 51 sterile	11 56 9 colonies
11 53 sterile	11 57 1 colony
11 57 sterile	11 59 400 colonies
12 03 128 colonies	12 05 800 colonies
12 10 660 colonies	12 14 1920 colonies
12 20 240 colonies	12 22 countless
12 30 countless	12 32 countless

Post-mortem examination showed a hyperæmia of the parietal and visceral peritoneum with 300 cubic centimeters of bloody fluid in the peritoneal cavity.

Two other dogs were studied in the same way with the same result each animal giving a very abundant growth of bacillus coli from the divided thoracic duct and from the peripheral blood stream. To the end of the experiment 45 minutes after the intraperitoneal injection of bacillus coli there was no tendency for the micro-organisms to diminish in number in either the chyle or in the blood.

We may conclude from these experiments that the bacillus coli injected into the peritoneum which contains a transudate formed by the previous injection of hypertonic glucose solution passes rapidly into the lymphatics and into the blood stream. The number of organisms appearing in the thoracic duct and blood under these conditions is much greater than that found from the normal peritoneum. Whatever benefit hypertonic glucose solution may have in the treatment of peritonitis it is probably not due to the inhibition of the passage of micro-organisms into the blood and thoracic duct lymph.

#### CONCLUSIONS

1 Evidence is presented that colon bacilli pass directly into the blood stream as well as into the lymphatics from the normal peritoneum.

2 A well developed plastic peritonitis prevents the passage of bacillus coli from the peritoneum into the blood stream or into the lymphatics emptying into the thoracic duct.

3 Lesser grades of peritonitis prevent the passage of bacillus coli into the blood stream but usually do not prevent its passage into the lymphatics.

4 Colon bacilli, injected into the peritoneum which contains a transudate pass rapidly and in great numbers into the chyle from the thoracic duct and directly into the blood stream.

5 By analogy we may assume that in a well developed general infectious peritonitis bacteria do not pass directly into the blood stream or into the lymphatics draining into the thoracic duct and that the major problem in peritonitis does not concern itself with the development of a septicæmia.

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## LATE RECURRENCE OF PEPTIC ULCER AFTER GASTRO-ENTEROSTOMY

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**D**URING the last few years there has been a very lively discussion among surgeons as to the indications for and merits of the operation of gastro enterostomy for peptic ulcer with marked divergence of opinion. It should be emphasized at the outset that peptic ulcer of the stomach is a very different disease from peptic ulcer of the duodenum. Although the two lesions may and probably do have a common cause, the clinical entities are quite distinct in their progression, prognosis and treatment.

For the treatment of gastric ulcer surgeons practically unanimously agree that gastro enterostomy alone is not an adequate procedure and should only be used in those rare cases in which local or general conditions are such as to render more radical measures difficult or hazardous. Excision of the ulcer or its destruction by the cautery (Balfour method) combined with gastro enterostomy and partial gastrectomy are the measures most generally recommended. Movnihan (15) advocates whole heartedly partial gastrectomy for gastric ulcer in the great majority of cases. He states in the last edition of his book *Abdominal Operations* that in the 10 years up to 1933 the mortality in cases of gastric ulcer in which gastrectomy was performed was 16 per cent. During this time he operated in 531 cases of duodenal ulcer and 164 cases of gastric ulcer. He has observed no jejunal ulcers or other untoward late results in the cases subjected to partial gastrectomy.

Balfour (3), the originator of the cautery method, states that partial gastrectomy is becoming more and more the operation of choice in cases of chronic gastric ulcer. In an analysis of 58 cases of ulcer of the stomach operated on at the Mayo Clinic between January 1, 1924, and the date of his paper, one half had been subjected to partial gastrectomy.

An undeniable advantage claimed for this operation is complete removal of the lesion,

which is of particular importance since these ulcers have been shown to have a certain tendency to become malignant. It also permits of the removal of multiple gastric ulcers. This view steadfastly advocated by Rodman (17) of Philadelphia many years ago is now held by many prominent surgeons in Europe and in this country.

When we consider duodenal ulcer we find on the other hand a very great divergence of opinion as to the best surgical procedure. The great majority stand by gastro enterostomy. W. J. Mayo (13), Movnihan (15), Peck (16), Sherren (19), Woolsey (20), Balfour (4), Scudder (18) and a host of other well known surgeons have enthusiastically endorsed this operation properly performed in selected cases of chronic duodenal ulcer. Impressive statistics have been adduced in support of their views.

Balfour (2) in 1924 reported the end results of 1,000 cases of gastro enterostomy for duodenal ulcer operated on at the Mayo Clinic more than 10 years previously. He found satisfactory results in 88 per cent of cases. Sherren (19) of London has reported 97.6 per cent of 500 cases perfectly well two or more years after operation. Both Balfour (1) and Sherren have stated that if there is relief from symptoms from 15 months to 2 years after gastro enterostomy, further recurrence is extremely unlikely. Such has not been my own experience. Peck (16) has reported 90.5 per cent of patients free from symptoms after gastro enterostomy.

From my own hospital the Massachusetts General Scudder (18) in 1922 reported the remote results in 94 cases of gastro enterostomy for duodenal ulcer, the time elapsed since operation varying from 1 year to 5 years. He found that 88 cases or 93.6 per cent were practically well.

Since the publication of Scudder's careful and painstaking report 7 patients have re-

entered the hospital with gastrojejunal ulcers who had had gastro enterostomy performed there during the period covered by the report, 6 of these might well have been included among those considered practically well at that time, as they had been free from symptoms for periods ranging from  $3\frac{1}{2}$  years to 10 years until shortly before re admission. In all 7 cases the diagnosis was proved by secondary operation. The details of some of these cases are included in the summary of personal cases at the end of this article. Although these subsequent recurrences are not perhaps sufficient in number to substantially alter Dr Scudder's favorable percentages, yet they are sufficiently distressing to the patient and harassing to the surgeon as to somewhat shake one's confidence in the lasting security of results obtained by gastro enterostomy.

Finney (6) in 1902, in looking about for a substitute for gastro enterostomy, brought out his modification of the operation of gastroduodenostomy for certain selected types of duodenal ulcer. Judd (9) has proposed the excision of those duodenal ulcers which show a marked tendency to hæmorrhage, where the local conditions permit of its performance. Such cases constitute perhaps 12 to 15 per cent of the total number of cases. Finney has combined excision with his original operation. Operations of this type have received quite general recognition in this limited field even from the advocates of gastro enterostomy.

Many prominent continental surgeons finding the results of gastro enterostomy for duodenal ulcer unsatisfactory, notably Haberer (8) and Finsterer (7), have turned to more radical measures. Haberer in 1920 reported 80 cases of partial gastrectomy by the Billroth I method without mortality, 35 of these were done for duodenal ulcer. In 536 gastrectomies he has never observed the development of jejunal ulcer.

In this country Lewisohn (10) traced 68 patients at the Mt Sinai Clinic 4 to 9 years after gastro enterostomy for duodenal ulcer, and found that 18 per cent of these cases required reoperation for gastrojejunal ulcer. Another 16 per cent had the clinical signs and x ray findings of gastro-jejunal ulcer, making a total of 34 per cent. Only 50 per cent of

his cases seemed to be permanently cured by gastro enterostomy. As a result of his studies and experience he draws the bold conclusion "that partial or subtotal gastrectomy should be the method of choice in the surgical treatment of gastric and duodenal ulcers."

Gastrojejunal ulcer is without doubt the most serious and distressing sequela of gastro-enterostomy. Many questions at once arise as to this complication. What is its cause? How often does it occur? Can it be prevented? What is its treatment? The last question is the most readily answered. As the result of increasing experience with these formidable cases it has become pretty generally accepted that undoing of the gastro enterostomy, excision of the ulcer, and partial gastrectomy is the operation of choice for gastrojejunal ulcer. Undoing of the gastro-enterostomy, excision of the ulcer, and gastroduodenostomy is advocated by some surgeons when the local conditions at the duodenum are favorable. Simple excision of the ulcer, or simple undoing of the gastro-enterostomy have proved to be inadequate procedures in cases in which the original operation was done for a definite chronic duodenal ulcer.

As to etiology it is obvious that just so long as the cause of peptic ulcer itself remains undetermined, the cause of gastro jejunal ulcer will remain obscure, the underlying causes of the two conditions undoubtedly being identical. Many causative factors have been assigned: (1) infection from a distant focus either within or outside the abdomen which has not been removed, (2) irritation of non-absorbable sutures at the stoma, (3) trauma or hæmatoma at the time of operation, (4) poor drainage of the stomach, the result of the stoma being too small or improperly placed, (5) improper diet after operation, especially excess in alcohol or tobacco, (6) action of the acid gastric secretion on the mucous membrane of the jejunum. This last, the so called acid erosion theory, is generally considered to be by far the most important factor. The experimental work of Mann and Williamson (11) and Morton (14) on dogs strongly supports this theory. This brings up another query. Does gastro enterostomy materially reduce the acidity of the gastric secretion?



Lewisohn (10) says it does not in the majority of cases while claiming that partial or subtotal gastrectomy effectually does do this. He also states that it is a well known fact that gastrojejunal ulcers practically never occur in an anacid stomach.

Sherren (19) found in 285 cases of gastroenterostomy only 37 in which the acidity was not reduced. Woolsey (20) believes that if gastro-enterostomy fails to reduce acidity this failure is due to some error in technique. Balfour (4) in a paper read before the American Surgical Association in 1926 reported 270 cases of gastrojejunal ulcer operated on at the Mayo Clinic. In 139 of these cases the original operation had been performed at the Mayo Clinic. The total number of gastroenterostomies for peptic ulcer performed at the Clinic up to this time had been 8,600, giving a percentage of gastrojejunal ulcers of 1.6 per cent.

Moynihan's percentage is about the same. Woolsey places it at 2 per cent. Balfour further says 'the fact that there was no free hydrochloric acid in one fifth of the cases of gastrojejunal ulcer in which repeated and fractional examinations of the gastric contents were made disproves the assumption that achlorhydria following the primary operation affords protection against later ulceration.'

Lewisohn (10) states: 'We seem to have one safe way of preventing a recurrent ulcer or a subsequent gastrojejunal ulcer, that is, the establishment of permanent anacidity by partial or subtotal gastrectomy.'

On the other hand C. H. Mayo (12) states that he has observed during the past year 2 cases of gastrojejunal ulcer following partial gastrectomy. A few similar experiences have been reported by others.

Out of this maelstrom of conflicting facts and opinions, what is to guide the course of the bewildered average surgeon? Although somewhat shaken in my former faith in gastro-enterostomy, I must acknowledge the logic and force of the views so well expressed recently by Balfour (5) in its defense.

Let us then hold fast to that which has proved fairly satisfactory in the past until the newer and more radical measures have

been thoroughly tried out by a few skillful and bold pioneers and proven to be better. To paraphrase the immortal bard let us rather for a time bear those ills (of gastro-enterostomy) we have, than fly to others that we know not of. No one could criticize a Mayo or a Moynihan if he should see fit to extend the scope of partial gastrectomy for peptic ulcer. But only incalculable harm could result from the general adoption of the principle of gastrectomy for duodenal ulcer by the average surgeon.

Reserving gastrectomy then for the severe cases of gastric ulcer and those intractable cases of recurrent ulcer following gastro-enterostomy, let us make sure that when we do perform gastro-enterostomy for duodenal ulcer that definite indications are present, that medical treatment has had a fair trial, that foci of infection elsewhere in the body have as far as possible been removed, that the operation is properly performed and finally that a careful dietary and hygienic regimen is carried out subsequently.

It is important that further data on the results of gastro-enterostomy be secured. The occurrence of late sequelæ such as recurrent duodenal ulcer and gastrojejunal ulcer after years of apparent well being, make it imperative that follow up studies be carried on with the pertinacity and thoroughness that are required in cancer statistics. Every case should be traced for 5 or better, 10 years. X-ray studies and analyses of gastric secretions should be made. When such reports are at hand from many diverse clinics we shall be in a much better position than we are to day to appraise justly the operation of gastro-enterostomy for ulcer.

#### CASE REPORTS

**CASE 1.** A Mc M. Hospital No. 242507, male, 50 years old, American, entered the hospital April 10, 1921. He had had a posterior gastro-enterostomy done at another hospital 7 years previously for what was considered to be carcinoma of the pyloric end of the stomach with obstruction. Lincusutures were used. He was free from symptoms for 6 years and 9 months after operation. Then he began to have severe pain, indigestion and vomiting. X-ray showed that the barium meal left the stomach entirely via the pylorus. The duodenum was irregular suggesting old scar or recent ulcer. Test

meal free hydrochloric acid 30, total acid 50. At operation a subacute perforation of a chronic duodenal ulcer was found. This was closed by suture. There was also a jejunal ulcer, the stoma of the old gastro enterostomy was the size of a lead pencil. No sign of the old sutures was seen. The old gastro enterostomy was undone, the jejunal ulcer excised, and a new gastro enterostomy was made. He made a good immediate convalescence.

The later history of this case is unknown but in view of subsequent experience in these cases, I am not optimistic concerning the result.

CASE 2 E H T, Hospital No. 251174, male, 18 years old, American, first entered the hospital April 27, 1917. A posterior gastro enterostomy with infolding of the duodenal ulcer and appendectomy was performed by another member of the staff. Some linen was used in the sutures. He was fairly well for 3½ years following his operation. On August 1, 1922, over 5 years after the first operation, he re-entered on account of epigastric pain and fainting spells. Transfusion was done twice while he was in the hospital. The haemoglobin was recorded once at 15 per cent and red cells 1,100,000. He was relieved by Sippey treatment and discharged.

In March, 1923, he was again re-admitted on the medical service with marked anaemia and tarry stools. He had followed the Sippey regime with great faithfulness. After a transfusion he was transferred to the surgical service, with hydrochloric acid, 31, total acidity 57. At operation there were marked adhesions about the duodenum but no induration or other evidence of active ulcer, the stomach appeared normal. The gastro enterostomy stoma admitted 2 fingers. About an inch from the stoma on the proximal loop of the jejunum there was an area of induration with a crater. This ulcer of the jejunum was excised without disturbing the gastro enterostomy.

Six months later he was again admitted with constant severe gnawing pain unrelieved by food, no vomiting, no tarry stools. The X-ray showed that the stomach emptied in a few minutes via the stoma, "dumping type." A small amount of barium was left by the pylorus. He was operated on for the third time, many adhesions about the stomach were found, but no evidences of definite gastric or duodenal ulcer were discovered. There was induration about the stoma and evidence of a jejunal ulcer, this was excised and the original gastro enterostomy closed. The patient had postoperative pneumonia, otherwise the convalescence was uneventful. He was now, after his third operation, put back in his original condition before any operation had been performed on his alimentary tract.

Eight days after his discharge from the hospital he was re-admitted in an alarming condition from haemorrhage. Large quantities of blood had been vomited and passed in the stools. Two transfusions

were done. Morphine, rest, and starvation, caused the bleeding to stop. On a restricted diet he gradually improved and 6 weeks later was sufficiently well to be able to leave the hospital. Since that time, December 1923, to date, he has been on an absolute milk diet devised by himself. He is free from symptoms and has the general appearance of good health though slightly pasty looking. He is able to carry on an active insurance business.

In spite of the terrible ordeal of unfortunate surgery through which this man has passed, he is now apparently happy and well, and cheerfully remarks that his sustenance costs him less than a dollar a day. This happy result cannot be credited to the surgery employed in his behalf, but is due to the pluck and perseverance of the patient, and the healing power of nature.

CASE 3 E P, Hospital No. 63480 Canadian gardener male 22 years old, entered the hospital June 9, 1924. He had had an operation said to be a gastro enterostomy for ulcer at another hospital ½ years previously with relief of symptoms for 6 months. Then the original symptoms of pain and vomiting recurred. The X-ray showed some delay in the passage of the barium through the stomach, all barium leaving by the pylorus. There was some irregularity on the lesser curvature and at the duodenum. There was no evidence of a gastro enterostomy stoma. The test meal resulted in free acid 55, total acid 65. At operation a posterior gastro enterostomy was found, the stoma just admitting one finger. There was marked induration of the jejunum close to the stoma. There was the scar of an old ulcer at the duodenum with very little induration. The gastro enterostomy was undone, and a small but definite jejunal ulcer excised. The patient made a good immediate recovery but 7 months later he re-entered the hospital with recurrence of symptoms of pain after eating, and frequent vomiting not relieved by soda or diet. The X-ray showed retention of over one third of the motor meal at 6 hours. There was a persistent irregular filling defect in the first portion of the duodenum. The free hydrochloric acid was 66 the total acid 80. At the third operation on February 11, 1925, a very definite ulcer of the first portion of the duodenum was found with induration and adhesions. The stomach itself was not remarkable. The antrum of the stomach consisting of a portion 3½ to 4 inches long was resected by the Billroth II method including the site of the previous gastro enterostomy. He made a fair recovery, but had some postoperative bleeding with the formation of a clot in the stomach which apparently obstructed the gastro enterostomy stoma until this was dislodged by stomach washing. After this the convalescence was smooth. He has remained well up to the present time.

In this case the second operation was ill advised giving ample opportunity for the reactivation of the original duodenal ulcer

CASE 4 M E Hospital No 80695 Hebrew age 40 entered the hospital on the medical service April 23 1915 complaining of dyspepsia of 5 years standing The X ray showed some irregularity of filling of the duodenum The test meal showed hydrochloric acid 89 The diagnosis of hyperacidity was made He was discharged to the Out Patient Department for treatment Three months later in July 1915 he re entered the hospital on the surgical service with a perforating duodenal ulcer He was immediately operated upon a perforation of the first portion of the duodenum was closed by sutures and a posterior gastro enterostomy done with linen sutures for the serous layer and chromic catgut for the inner layers He made a good recovery and for 2 or 3 years felt very well Then he began to have typical hunger pains which were at first relieved by soda and milk He got along quite well by careful attention to diet until 4 weeks previous to his last entry to the hospital when the pain became much more severe accompanied by frequent vomiting of dark material He entered the hospital for the third time on December 22 1926 The X ray showed gastric retention A small amount of barium could be seen to pass through the stoma The findings were suggestive of jejunal ulcer Upon operation a perforating gastrojejunal ulcer was found with its base formed by the mesocolon A partial gastrectomy was done the ulcer of the jejunum excised and a retrocolic end to side anastomosis performed No signs of unabsorbable sutures were found at the stoma There was some thickening and scarring in the region of the original duodenal ulcer The patient made an uneventful immediate recovery

CASE 5 St O Hospital No 280100 Canadian American male 46 years old entered the hospital November 20 1926 complaining of vomiting and a foul taste in the mouth Seven years before admission he had a posterior gastro enterostomy for duodenal ulcer performed at another hospital He was completely relieved of his symptoms for over 3 years He then had occasional attacks of pain and noticed tarry stools and vomiting of blood on one or two occasions Four months before admission the pain ceased and he began to have marked diarrhea with constant nausea and frequent vomiting of very foul material Nineteen years previous to his admission he had appendectomy 13 years previous cholecystectomy Test meal free acid 70 total acid 90 guaiac negative X ray showed no 6 hour residue in the stomach It emptied almost immediately through the gastro enterostomy so that neither the pyloric end of the stomach nor the duodenum could be well visualized A barium enema showed that the colon filled normally as far as the middle third of the transverse colon At this point the stomach as well as the remainder of the colon began to fill also There appeared to be a small amount

of small intestine connecting the stomach with the colon Following the barium enema air was forced into the colon which was rapidly filled the stomach was also distended by this air and the patient began to belch After the barium enema 200 cubic centimeters of barium was washed from the stomach The diagnosis of gastrojejunal fistula was complete On November 25 he was operated upon The stomach was found buried in adhesions which separated fairly easily The portion of the stomach containing the fistula was freed There was an opening admitting one finger from the stomach into the jejunum and from the stomach into the colon The colon and jejunum were freed from the stomach and from each other Although the wall of the colon was considerably indurated there was no sign of an active ulcer either here or at the site of the stomach between the jejunum and the stomach The opening in the colon was closed longitudinally causing some constriction of its lumen The opening in the jejunum was closed transversely The pyloric third of the stomach was then resected There was definite evidence of an old ulcer in the second portion of the duodenum The jejunum was united to the stomach by a retrocolic end to side anastomosis A catheter was inserted into the transverse colon distal to the suture line with its end passing through the narrowed segment Convalescence was complicated by a severe parotitis He eventually recovered and left the hospital in excellent condition

CASE 6 I C B Hospital No 280615 male age 47 American entered the hospital December 17 1926 For 20 years he had suffered from dyspepsia with exacerbations and remissions with severe hemorrhages on several occasions Nine years previously he was operated on at another hospital the appendix was removed and something done to the stomach Symptoms were relieved only temporarily and 8 years ago he had a posterior gastro enterostomy with trans section of pylorus for ulcer at still another hospital He got along very well for the next 8 years with only occasional slight attacks of gnawing pain and nausea which were relieved by bismuth powders until 10 days ago Then he began to vomit dark blood and pass tarry stools At admission he showed marked anemia After one week of rest in bed on a gastric diet he had a severe hemorrhage Transfusion was done the hemorrhage recurred 2 days later transfusion was done again and operation performed immediately The red count fell to 2 240 000 and the hemoglobin to 40 per cent at the lowest At operation the stomach was found dilated with marked adhesions in the region of the pylorus which had been divided at the previous operation There was no sign of ulcer on the anterior surface of the stomach or along the lesser curvature There was no induration to be felt in the region of the gastro enterostomy stoma which readily admitted 3 fingers The jejunum appeared normal The colon was distended with blood The first portion of the duodenum was distended dark in color and what seemed like an

ulcer on the posterior wall was palpated. The duodenum was opened but no ulcer was found. The stomach was then opened and the gastro enterostomy stoma carefully inspected and found to be negative. After removal of a large quantity of clotted blood from the fundus of the stomach a large indurated ulcer on the posterior wall adherent to the pancreas was found. The base of this was lightly cauterized and the edges brought together with catgut sutures. After a stormy convalescence the patient slowly improved and was discharged from the hospital on February 13, 1927. Although there was no macroscopic postoperative bleeding the guaiac test was positive on many occasions.

The surgical treatment of hemorrhage from chronic peptic ulcer is a very perplexing problem. In this case the condition of the posterior wall of the stomach should have been investigated at once by opening the gastrohepatic omentum, the approach from below being shut off by the posterior gastro enterostomy. The indurated ulcer of the posterior wall having been found, it should have been freed from the pancreas and either excised or destroyed by the cautery and sutured, or preferably a partial gastrectomy done if the patient's condition had warranted it, which in my opinion it did not in this case. The procedure adopted was merely palliative, and the only excuse for it was that so much time had been wasted in finding the lesion that it was not deemed safe to do anything more radical. In my opinion this man should return later for a partial gastrectomy.

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CASE 6 I C B Hospital No 280615 male age 47 American entered the hospital December 17 1926 For 20 years he had suffered from dyspepsia with exacerbations and remissions, with severe hemorrhages on several occasions Nine years previously he was operated on at another hospital the appendix was removed and something done to the stomach Symptoms were relieved only temporarily and 8 years ago he had a posterior gastro enterostomy with trans section of pylorus for ulcer at still another hospital He got along very well for the next 8 years with only occasional slight attacks of gnawing pain and nausea which were relieved by bismuth powders until 10 days ago Then he began to vomit dark blood and pass tarry stools At admission he showed marked anemia After one week of rest in bed on a gastric diet he had a severe hemorrhage Transfusion was done the hemorrhage recurred 2 days later transfusion was done again and operation performed immediately The red count fell to 2 240 000 and the hemoglobin to 40 per cent at the lowest At operation the stomach was found dilated with marked adhesions in the region of the pylorus which had been divided at the previous operation There was no sign of ulcer on the anterior surface of the stomach or along the lesser curvature There was no induration to be felt in the region of the gastro enterostomy stoma which readily admitted 3 fingers The jejunum appeared normal The colon was distended with blood The first portion of the duodenum was distended dark in color and what seemed like an



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CASE 4 M E Hospital No 80693 Hebrew age 40 entered the hospital on the medical service April 23 1915 complaining of dyspepsia of 5 years standing The X ray showed some irregularity of filling of the duodenum The test meal showed hydrochloric acid 89 The diagnosis of hyperacidity was made He was discharged to the Out Patient Department for treatment Three months later in July 1915 he re-entered the hospital on the surgical service with a perforating duodenal ulcer He was immediately operated upon a perforation of the first portion of the duodenum was closed by sutures and a posterior gastro enterostomy done with linen sutures for the serous layer and chromic catgut for the inner layers He made a good recovery and for 2 or 3 years felt very well Then he began to have typical hunger pains which were at first relieved by soda and milk He got along quite well by careful attention to diet until 4 weeks previous to his last entry to the hospital when the pain became much more severe accompanied by frequent vomiting of dark material He entered the hospital for the third time on December 22 1916 The X ray showed gastric retention A small amount of barium could be seen to pass through the stoma The findings were suggestive of jejunal ulcer Upon operation a perforating gastrojejunal ulcer was found with its base formed by the mesocolon A partial gastrectomy was done the ulcer of the jejunum excised and a retrocolic end to side anastomosis performed No signs of unabsorbable sutures were found at the stoma There was some thickening and scarring in the region of the original duodenal ulcer The patient made an uneventful immediate recovery

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ulcer on the posterior wall was palpated. The duodenum was opened but no ulcer was found. The stomach was then opened and the gastro-enterostomy stoma carefully inspected and found to be negative. After removal of a large quantity of clotted blood from the fundus of the stomach a large indurated ulcer on the posterior wall adherent to the pancreas was found. The base of this was lightly cauterized and the edges brought together with catgut sutures. After a stormy convalescence the patient slowly improved and was discharged from the hospital on February 13, 1917. Although there was no macroscopic postoperative bleeding the guaiac test was positive on many occasions.

The surgical treatment of hemorrhage from chronic peptic ulcer is a very perplexing problem. In this case the condition of the posterior wall of the stomach should have been investigated at once by opening the gastrohepatic omentum, the approach from below being shut off by the posterior gastro-enterostomy. The indurated ulcer of the posterior wall having been found it should have been freed from the pancreas and either excised or destroyed by the cautery and sutured, or preferably a partial gastrectomy done if the patient's condition had warranted it, which in my opinion it did not in this case. The procedure adopted was merely palliative, and the only excuse for it was that so much time had been wasted in finding the lesion that it was not deemed safe to do anything more radical. In my opinion this man should return later for a partial gastrectomy.



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ably simultaneous with recurrent hæmorrhages. Hæmaturia occurs in practically half of the cases, being particularly profuse in those instances in which the aneurism perforates into the kidney pelvis. Repeated attacks of hæmaturia are explicable on the same basis as the periodic attacks of pain. The tumor of the loin may assume small or large proportions and, depending upon the rate of escape of blood from the ruptured artery, the tumor may enlarge imperceptibly or with surprising rapidity. On account of the small caliber of the renal artery a saccul-tion of a portion of it hardly reaches sufficient size before rupture to give the usual pathologic physical findings of aneurism. Thus expansile pulsation, palpable thrill, and audible bruit are only very occasionally reported. In one case a systolic murmur was heard over the region of the tumor. Tenderness is variable, being elicited as a rule, however, when the hæmatoma ruptures into the peritoneal cavity or peritonitis is present. Not infrequently vomiting, usually of a reflex nature, is a prominent symptom. Tympanites is a common occurrence tending to obscure the physical findings and leading in some cases to the suspicion of an acute surgical condition of the abdomen.

In the 29 cases he collected until the year 1922 Vogeler (17) found that diagnosis of aneurism of the renal artery was made pre-operatively or antemortem in only 5 instances. In 1 case mentioned by Vogeler, that of Armstrong (1), there was apparently an error in translation for according to the original article hæmorrhage was not suspected clinically, the diagnosis of tumor of the right kidney being made. In the other 4 instances to which Vogeler referred, so far as could be ascertained, a very definite history of trauma antedated the onset of symptoms. It is quite apparent, therefore, that in the absence of the knowledge of an injury the diagnosis of a renal aneurism is seldom made.

Of the same 29 cases referred to, 4 were incidental findings at postmortem, while the remainder gave the train of symptoms mentioned above. Of the 25 clinical cases, 7 came to operation, 6 of which recovered. Of the 18 nonoperative cases, all ended fatally. The

duration of the illness was from 2 days to 14 years, 11 patients dying within the first year. In 1 case Orth (14) sutured a tear the result of a stab wound of the renal artery, whereas in the remainder of the operative cases nephrectomy was resorted to.

Perirenal hæmorrhage having an etiology other than aneurism of the renal artery or its branches was according to Sohn (16) first mentioned by Raye in 1839, but the condition was not fully described until 1846, when Wunderlich (18), in his *Handbook of Pathology and Therapy*, described in connection with affections of the kidney bed, a rare disease characterized by massive hæmorrhage and termed it "Apoplexie des Nierenlagers." Subsequent reports dealing with hæmorrhage about the kidney from a variety of causes other than aneurism have been classified as perirenal hæmatoma, of which in 1910 Coenen (3) was able to collect 16 cases (including 3 instances of the so called perirenal hygroma). The literature until 1921 was splendidly summarized by Sohn (16), and more recently by Greco (7), who succeeded in gathering 62 cases a few of which, however, could more appropriately be included under aneurism of the renal artery.

The distinction is usually made anatomically of hæmorrhage (a) between the kidney and its true capsule (b) between the layers of the fibrous capsule, and (c) in the fatty tissue about the kidney. One can therefore distinguish (a) subcapsular, (b) intracapsular, and (c) extracapsular forms, although it is to be borne in mind that combination forms are frequent. Clinically, however, the differentiation is most difficult and at times impossible.

Aside from lesions of the renal artery and its main branches, causes of perirenal hæmatoma may be divided for purposes of classification into (1) disease of the kidney parenchyma and smaller renal vessels, (b) primary hæmorrhage from the fibrous or fatty capsule of the kidney, (c) morbid processes of retroperitoneal structures other than the kidney or its capsule, and (d) blood dyscrasias. In the first group, that is, in diseases of the kidney itself, the hæmorrhage at the outset is manifestly subcapsular, but as the retained blood increases in amount, rupture of the

distended capsule occur and extension into the perinephritic tissues follows.

Perirenal hemorrhages arising from the renal parenchyma are described as a result of a variety of tumors including hypernephroma, carcinoma, sarcoma and multiple cavernomata. Renal tuberculosis may cause hemorrhage into and about the kidney in a manner similar to that in which pulmonary tuberculosis produces bleeding in the lung and air passages. Purulent processes within the kidney may lead to perirenal hemorrhage either as a result of an ascending infection or following the lodgment of an infected embolus with the subsequent formation of a metastatic pyæmic abscess. One of us (13) in 1919 reported a case in which the perirenal hemorrhage was the result of ascending infection. Secondary suppuration presumably of hematogenous origin in the presence of polycystic disease has been found associated with perirenal hemorrhage. What has been said concerning the etiology of aneurysms in general applies to affections of the smaller blood vessels. Such factors as nephritis, nephrolithiasis, hydronephrosis and polycystic disease have been wrongly considered the sole cause of perirenal hemorrhage. However in these cases one must assume the presence of another factor such as an abnormal fragility of the vessels or a blood dyscrasia; otherwise it would be difficult to account for the rarity of perirenal hematoma as compared with the frequency of nephritis for instance.

Most puzzling are the cases of so-called primary or essential perirenal hematoma that are exclusively intracapsular or extracapsular. In these cases the hemorrhage has its origin entirely outside of the kidney, the capsule throughout its extent being intact. The explanation of recurrent capsular bleeding offered by Coenen (3) that is the presence of a hemorrhagic perinephritis finds its analogy in a hemorrhagic pachymeningitis and is supported by microscopic evidence. Wunderlich (18) in his classical description of the condition published in 1846 called attention to the perinephritis which supervened upon inflammation of the kidney and its pelvis. Evidence has been adduced in support of the contention that the inflammation can by

further extension involve the fatty capsule and as a result of tears in the delicate granulations eventuate in threatening extrarenal hemorrhage. Other hypotheses for the origin of the escape of blood into the kidney capsule have been suggested including a complicated vasomotor disturbance promulgated by Ricker (15). The occurrence of capsular hemorrhage in the presence of a hydronephrosis led Baggerd (2) to associate the two ascribing the hemorrhage to the vascular changes induced by the compression.

The next group of causes comprising lesions other than those involving the kidney or its capsule include aneurysm of the abdominal aorta and of the ovarian artery, hemorrhages from the adrenal gland, and from retroperitoneal tumors such as angiosarcomata. In 1925 a patient at the Cook County Hospital was transferred to the Urological Service on account of a tumor of the loin which suggested the presence of hydronephrosis. At operation a perirenal hematoma was found and packing resorted to. The autopsy disclosed an aneurysm involving the abdominal aorta which had eroded the spine and ruptured a massive accumulation of blood in the right loin resulting.

Hæmophilia is the most important representative of group (d) namely, the blood dyscrasias. The hemorrhage arises frequently from the lumbar muscles and from the standpoint of source of origin might be included under the morbid processes of retroperitoneal structures other than the kidney or its capsule. The loss of blood in this group is by diapedesis but nevertheless as will be seen later may be quite alarming.

The symptoms associated with the non-aneurysmal group of perirenal hematomata are summarized by Lenk (12) in the form of a triad, namely severe pain, signs of internal hemorrhage and a rapidly growing retroperitoneal tumor in the loin. The severity of the pain at the outset may be of sufficient degree to produce unconsciousness so that when the pain is associated with anuria, uræmia may be suspected. Repeated attacks of pain due to recurrences of the hemorrhage may be present as in aneurysm of the renal artery. The evidences of internal hæmor-

rhage are obviously dependent upon the amount of blood lost the degree of anemia being as a rule directly proportional to the size of the hematoma. Hematuria of the severe grade frequently associated with aneurisms not described in this group, otherwise the remaining symptoms are quite similar.

It would appear that in those cases in which the cardinal symptoms were manifested (severe initial pain, signs of internal hemorrhage and a rapidly enlarging tumor in the loin) the presence of a perirenal hematoma would be readily suspected. However according to Sohn (16), who reviewed the literature until 1921, only 3 cases up to that time were correctly diagnosed clinically (Doll 5, 1907; Richer 15, 1911; Laeven 11, 1912). It is noteworthy that in all three instances these clinicians had had under their care previously one or more similar cases.

It is the consensus of opinion that the prognosis depends entirely upon the treatment conservative handling resulting almost invariably in a fatal outcome whereas operation carries with it a mortality of approximately 60 per cent.

In order to make the picture of perirenal hemorrhage clear and to impress upon the minds of the readers the clinical manifestations of the condition we can do no better than to relate a case which we recently were fortunate enough to diagnose and subsequently cure through operation.

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#### CASE REPORT

M. H., a white female, 46 years of age, was admitted to the medical service of Dr. W. Quigley at the Cook County Hospital, August 22, 1936, at midnight, complaining of severe abdominal pain and persistent vomiting. Both symptoms having been constantly present for the past 7 days. Two previous similar attacks, neither as severe nor as prolonged, were suffered during the 2 months preceding her entrance into the hospital. The pain which was sharp and stabbing, located in the right loin, passing at times to the right upper quadrant, was relieved only by a hypodermic of morphine. The patient's statement concerning her frequency of vomiting (every few minutes) was evidenced by her almost continuous retching, but in spite of her inability to retain food obstipation was absent. She had noticed for a week the presence of a mass in the right side of the abdomen without any increase in size. No other information was obtained except perhaps that she was assaulted 7 years previously and suffered a

also laceration then as a result of a blow on the head.

Physical examination disclosed a rather poorly nourished and developed white female who moaned incessantly and was apparently suffering acute pain. Her tongue and the emesis of a bile-stained thin fluid frequently interrupted the groaning. The forehead was covered with large beads of perspiration obviously not the result of the atmospheric temperature for the room was comfortably cool. The only noteworthy finding was the presence of an abdominal mass the size of a lemon located to the right and slightly above the level of the umbilicus, firm, elastic, smooth, only very slightly tender, having no respiratory mobility. Bimanual palpation of the right loin imparted the impression that the tumor mass lay anterior to the kidney. Ventral pressure caused a smooth structure (posterior kidney surface) to come in contact with the inferior palpating hand. The examination was facilitated by the thin abdominal wall and the absence of distention, rigidity, or marked tenderness.

The blood pressure was 130 millimeters systolic and 90 millimeters diastolic. The entrance temperature was 99 degrees F. The pulse rate 86 and respiratory rate 4 per minute. The white blood count was 11,400 of which 82 per cent were polymorphonuclear leucocytes. The hemoglobin reading was 75 per cent while the erythrocytes numbered 3,750,000. In the urinary sediment no abnormal constituents were found. The following day the patient was examined and the conclusion reached that the symptoms were due to a hemorrhage either intraperitoneal or extraperitoneal, or to the twisting of an abdominal tumor or viscus upon its pedicle. The condition was looked upon as surgical but before consultation was sought, cystoscopic examination was done to ascertain the functional capacity of the left kidney in the event that at operation the question of a right nephrectomy should arise. Cystoscopic examination by Dr. H. Katz undertaken the following morning yielded the findings of a normally functioning left kidney and an obstructed ureter on the right side which obstruction could readily be overcome, since the injection of 5 cubic centimeter amounts of water into the ureteral catheter produced a return flow of 4 or 5 drops of urine, colored by the test dye injected intravenously.

It was apparent that the abdominal mass was steadily increasing in size, having acquired twice its original proportions within the 24 hours following admission. On the basis of the rapid enlargement of the tumor mass it seemed reasonable to assume the presence of the already suspected hemorrhage. Although the mass was situated anteriorly, so that inspection of the abdomen with the patient in the recumbent position revealed a projection above the surface of the ventral abdominal wall, the tumor was considered to be of retroperitoneal origin, since it was well circumscribed and well demarcated in contradistinction to intra-abdominal hemorrhages which are as a rule diffuse and difficult to outline.

The findings resembling closely those previously seen in cases of hemorrhage about the kidney the diagnosis of perirenal hemorrhage compressing the right ureter readily suggested itself. The patient was interrogated again relevant to the possibility of trauma to the loin but could recall no injury to this region. Arterial disease could not be demonstrated for the peripheral vessels were normal in consistency the Wassermann was negative no signs of periarthritis were exhibited involving the superficial vessels nor could an increased fragility of the finer radicles of the skin of the arms be elicited. No evidence of a blood dyscrasia was demonstrable for the bleeding and clotting times respectively were normal and the number of platelets estimated in the blood smear was increased rather than decreased. Signs and symptoms of a suppurative process or a history thereof were likewise lacking. The patient was sent to operation with the diagnosis of perirenal hematoma of undetermined origin.

Local anesthesia was used because the condition of the patient was such that prolonged general anesthesia was not advisable. Through an S shaped kidney incision a mass of clotted blood located especially anterior to the kidney was exposed. In an attempt to discover the source of the hemorrhage it was necessary for purposes of exposure to remove portions of the hematoma that were somewhat firm and adherent with the result that the patient complained bitterly and the administration of a gas anesthetic was instituted at this point. Upon exposing the pedicle of the kidney there was encountered in the proximal portion of the anterior surface of the renal artery a perforation from which a jet of blood escaped with each cardiac pulsation. The demonstration of this lesion to the satisfaction of the physicians present was hardly completed when the patient's condition became precarious and it was necessary to clamp the bleeder and institute measures of stimulation and fluid replacement. Unfortunately the proximity of the location of the perforation to the point of origin of the renal artery precluded the possibility of applying a clamp proximal to the site of the lesion. The kidney was removed without further delay in the usual manner and two iodoform drains inserted. The convalescence through the aid perhaps of several saline transfusions and one blood transfusion was rather uneventful although for a time the prognosis seemed grave. During the postoperative course a considerable amount of a purulent material was discharged from the wound which on smear showed in addition to pus cells the presence of cocci in chains and clusters.

Grossly the extirpated kidney presented no noteworthy alterations except for the presence of clotted blood covering its surface. In the hilus the clots were white and somewhat firm elsewhere dark red. For the most part the hematoma was rather intimately adherent to the kidney capsule (Fig. 1). The renal artery together with its main branches except for a few raised yellow plaques was unchanged.

At the lower pole the veins were occluded by recent thrombi apparently due to stasis the result of external pressure exerted by the extravasated blood. The fibrous capsule was intact and the kidney parenchyma normal in all respects. Microscopically except for a patchy intimal thickening of slight degree no remarkable changes were present in the main renal artery or its branches (it is to be remembered that for reasons already stated the renal artery was divided distal to the point of rupture). In the fat of the hilus however a clue to the origin of the perforation was found. Infiltrating the fatty areolar tissue are found inflammatory cells and fibrin but no evidence of either recent or old hemorrhage in the form of blood or blood pigment. In passing from this zone of inflammatory exudation one finds a proliferation of fibroblasts and the presence of many newly formed vessels (Fig. 2). The vascular elements consist of spaces lined by endothelium about the majority of which a deposit of material of varying thickness undergoing fibrinoid necrosis is found. On the basis of the data available it appears that a focus of suppuration of undetermined origin located at the root of the kidney led to an erosion of the renal artery and the formation of an aneurysmal dilatation with subsequent rupture. The changes in the fat about the hilus as well as the profuse purulent discharge from the operative wound are attributable so far as can be ascertained to a cryptic infection about the kidney pedicle.

Our experience with 4 cases has taught us to look upon spontaneous perirenal hematoma (in a broad sense) as a definite entity demanding as a general rule immediate surgical intervention. The symptoms which characterize this affection irrespective of the etiology are pain of a severe type signs of internal hemorrhage formation of a perceptibly enlarging tumor mass in the loin and at times hematoma and signs of peritoneal irritation. From a consideration of these cardinal symptoms alone it is frequently impossible to diagnose the primary cause of the hemorrhage for as a rule the severity of the pain is independent of the mode of escape of blood and curiously enough the pain is frequently of equal intensity in hemorrhage by diapedesis or by rhexis. As a matter of fact capillary oozing in primary hemorrhage of the fatty capsule of the kidney is associated at times with more exquisite pain than rupture of the main renal vessel. The signs of internal hemorrhage occur likewise irrespective of the caliber of

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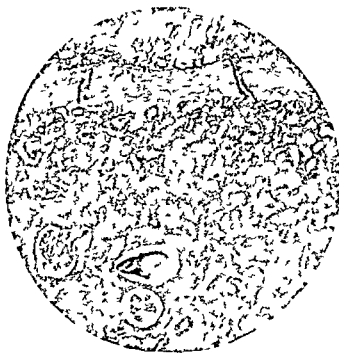


Fig 1 Section taken from the renal convexity showing the relationship of the early organizing blood clot to the greatly thickened fibrous capsule of the kidney. The vascular elements in the clot are all of the capillary type. A small cyst with hyaline contents is seen within the kidney parenchyma ( $\times 65$ )



Fig 2 Section from the tissue about the kidney pedicle. The normal loose fat is almost entirely replaced by granulation tissue rich in blood vessels the walls of which show a wide variation in thickness. Those vessels which have greatly thickened walls are for the most part in a state of fibrinoid necrosis ( $\times 65$ )

the vessel involved, for it has been repeatedly observed that rapidly developing anæmia is just as likely to occur when a bleeding point is too small to be demonstrable as when aneurisms of the renal artery are largest. The tumor mass in the loin, the result of an accumulation of blood in an anatomical bed when the patient assumes a recumbent position, can reach just as large proportions in primary hæmorrhage of the capsule as it can in aneurisms of the renal artery. The occurrence of hæmaturia, although far more frequently associated with perforation of the renal artery is not invariably present in this condition, whereas primary extracapsular hæmorrhage may be associated with independent hæmorrhage into the pelvis and hæmaturia (Baggerd, 2). Evidences of peritoneal irritation are conditional upon factors other than the point of origin of the hæmorrhage, for the tenderness, rigidity, and meteorism encountered in perirenal bleeding may be due to any one of a number of causes.

The separation of renal aneurisms from all other causes of perirenal hæmatoma is bewildering to the clinician and therefore un-

justifiable. The term perirenal hæmatoma should be employed by clinicians as well as pathologists (Fahr, 6) in a broad sense to cover all conditions leading to the production of an accumulation of blood in the loin. Aneurism of the renal artery would then be only one of the causes of circumrenal bleeding and unless the history or concomitant manifestations point to a definite causal factor, the diagnosis of perirenal hæmatoma of unknown etiology should suffice.

We are disposed to look upon perirenal hæmatoma as we do upon intestinal obstruction. The diagnosis of mechanical bowel obstruction being established, the indication for operation is usually clear. The pre-operative knowledge of the etiology though highly desirable is not essential in the decision as to the type of management, whether medical or surgical, to be followed, and the presence of a perirenal hæmatoma being established, whether or not the cause is known, the case with few exceptions becomes a surgical one.

It is noteworthy that in all 4 cases of spontaneous perirenal hæmatoma in which the pre-operative diagnosis was correctly made, the



examining clinician had had the opportunity of dealing with a similar case previously. It is apparent therefore, that the almost universal failure to diagnose correctly cases of spontaneous perirenal hæmorrhage is attributable in a great measure to the lack of acquaintanceship with the clinical picture produced by the condition. It is hoped that the acceptance of the conception that perirenal hæmatoma is an affection characterized by definite symptoms (severe pain signs of internal hæmorrhage a rapidly increasing tumor of the loin with at times signs of peritoneal irritation and hæmaturia) will lead to a more frequent *intra vitam* recognition of the disease. It is furthermore hoped that the adoption of the viewpoint by both internists and surgeons that the diagnosis of perirenal hæmatoma calls for immediate surgical intervention (even though the etiology preoperatively be obscure) will result in timely operative treatment in a greater number of cases.

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## ARTIFICIAL IMPACTION IN HIP FRACTURES

BY FRED J. COTTON M.D. F.A.C.S. BOSTON

ARTIFICIAL impaction at the hip, proposed and carried out by me in 1908, and consistently used since then means the operative production of an impaction comparable to the best accidental impaction. Such impaction is produced only after accurate reduction of fragments.

Impaction is not in itself a complete method of treatment but the step that happily initiates treatment, that enables us to secure a functioning hip. I have used the method many times and believe in it. Before going into the reasons why, certain points must be made clear.

Only because there seems to be, even today, a world of confusion as to the classification of hip fractures, should one spend time in the discussion of their classification or dwell on the importance of keeping the distinction of the established classes clean cut and clear. Some time ago Sir Astley Cooper made all this clear, but we have forgotten his teachings, indeed, until very lately at least, we have entirely forgotten.

There are three classes of hip fractures and only three: (1) extracapsular fractures, not impacted, (2) intracapsular fractures, impacted well or ill, or not at all, and (3) epiphyseal separations, endocrine or really traumatic, in essential causation.

Most writers and most players of special "systems" have confused classes 1 and 2, and have, therefore, had and claimed results that are difficult of analysis because of this utter confusion between the one class that can not help but give bony union and the other class that can at best be coaxed into uniting by bone only in a percentage of cases, which until very lately was very low. The epiphyseal separations are not fractures at all, and I shall not discuss them in detail now. Whitman published an admirable and conclusive series of articles on the treatment of such cases years ago.

Intermediate cases no doubt occur but they are very rare and belong essentially in class 2.

Accordingly we have to consider (1) extracapsular fractures, the trochanteric, pertrochanteric, or intratrochanteric fractures which are indeed all one thing (Fig. 1)<sup>1</sup> and (2) intracapsular or subcapital fractures (Figs. 2 and 3).

## EXTRACAPSULAR FRACTURES

In extracapsular fractures the lesion varies in different cases. Figure 1 shows the common type. The class 1, extracapsular, fractures, occur at any age—my youngest patient was 4 years of age, my oldest 89. They are the result of the same trauma, a sideways fall on the buttock, that produces most of the hip fractures. Here and there is a case, usually that of a young man, who has suffered the lesion after a severe fall on the side. Clinical diagnosis based on the history, age, and clinical examination of the patient has failed me too often. At best it is a guess. Either type may be present at any age, in any case. The X-ray is the only sure method of making a diagnosis.

Given a fracture which has been diagnosed as of the extracapsular type, we know we shall get union by bone, in spite of every failure in skill of treatment. The problem is, very simply, the avoiding of deformity, including shortening, and the minimizing of the loss of motion at the hip. Consideration of these matters need not delay us long for the mechanical problem presented is simple. There is no place for artificial impaction in this class. The whole aim of treatment is to correct coxa vara displacement, to guard against its recurrence, to avoid the establishment of any contracture of adductors, to correct outward rotation and to keep it corrected, and to institute motion as early as is safe.

The logical treatment in this class is the Phillips Maxwell-Ruth scheme of longitudinal traction, combined with lateral (outward) traction, applied close up to the crotch. This treatment works out very well, and I have used it with success.

<sup>1</sup> The separate splitting off of the lesser trochanter which is the usual happening seems of no clinical importance. Impaction that is real impaction is rare.

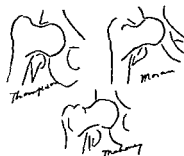


Fig 1 Shows the common types of extracapsular fracture

A like result may be obtained by abduction in plaster but with this procedure there is a chance that the bone may slip or may go into a coxa vara position. Therefore if one elects this method frequent X ray examination should be made to check up the progress.

The remaining method the one I prefer to use is that of traction with the limb in abduction. The angle of abduction should be about 30 degrees the weight applied 10 to 20 pounds.

There is no advantage in this method over that of longitudinal and lateral traction save that it is more nearly fool proof and avoids the possibility of interfering with the circulation which even O'good's ingenious binder's board collar about the thigh does not quite eliminate if lateral traction is used. May one say however that the results are just as good by my method? There is in this class abundance of nutrition and prompt repair with callus. Union is firm at 6 weeks is solid at 8 as a rule the limb can bear a bit of weight at 10 weeks and is quite strong at 12 weeks. The patient is able to go to work in from 15 to 6 weeks. Usually movements may be begun in 7 to 8 weeks. As a rule no convalescent splint is needed. Usually the terminal damage is confined to some loss of motion at the joint with perhaps a half inch of shortening which is of no consequence if adductor contracture has been avoided. Bony union occurs always.<sup>1</sup>

Extracapsular fractures present no serious problem and should be kept distinct from the intracapsular fractures.



Fig 2 Intra-capsular fracture—abortion under routine treatment. Unfortunate result

### INTRACAPSULAR FRACTURES

Intracapsular fractures otherwise called subcapital fractures or high fractures of the neck are the real source of trouble. These and these only give the loose sloshing useless hips so well known that are still so common so calamitous and so little a credit to our profession. The lesion in these cases is typical. They result from various falls or most often from just sitting down sideways on the street or on the house floor. They most commonly occur in clumsy old folk who tumble down in a lax fashion. The ratio as to sex is 8 or 9 women to every man. They are found not rarely in middle aged folk and sometimes in the young. There is no real or serviceable age differentiation as concerns the intracapsular and the extracapsular fractures. The differential diagnosis cannot be made without the aid of the X ray.

Some such fractures are loose from the beginning some loosen up some are impacted and remain so. The degree of impaction if present varies. One sees types A (Figs 26, 34 and 37) type B (Fig 3) and Type C (Fig 4) and of these unfortunately type C is commonest while type D (Fig 5) the same save for grotesque outward rotation<sup>2</sup> is not rare.

Type A is the loose unimpacted fracture which fails to unite unless reduced and impacted or very firmly held.

Type B is apt to do well under any treatment sometimes with none and type C may do as well though impaction is poor mechanically poor for repair.

<sup>1</sup> If the bone goes right through the neck for but that it does not break in the X-ray film by the compression of the lesser trochanter normally posterior or better at an angle that the limb will not

<sup>2</sup> If the bone goes right through the neck for but that it does not break in the X-ray film by the compression of the lesser trochanter normally posterior or better at an angle that the limb will not



Fig. 3. Accidental impaction—broad surfaces opposed impaction seemingly very deep. This patient though nearly 20 years old recovered with a perfectly useful hip.

Either type may, however, fall apart under the normal absorption process which is to be taken up presently, and types C and D do so rather commonly.

The fact is, however, that under usual routine treatment the loose fractures stay loose, the poor impactions usually loosen up, and only the firm impactions get bony union.

Moved by the depressing findings in a review of the end results shown in a follow up of hospital cases, I conceived, many years ago,<sup>1</sup> the scheme of artificial impaction of impaction produced by driving the fragments together so as to imitate the condition of favorable impaction that is occasionally created by the chance of the fall. There seemed nothing to lose in the loose cases, nothing worth counting a loss in reducing the unfavorable cases into favorable position, and then impacting them.

The method used was, then as now, a reduction by dragging the leg down (with counter pressure by the stockinged heel in the crotch) to equal length with the other leg, to exact correction, as near as may be. Then the leg is carried into moderate abduction and into sharp internal rotation, and held there, while a strong assistant steadies the pelvis.

A big wooden mallet—mine is of lignum vitae—originally of about 7 pounds weight is used to impact the break. Impaction is by a succession of slow swings—"following" blows



Fig. 4 (left) False impaction—merely a spiking of the loose head by the spur left on the lower side of the neck. Very little mechanical stability. Very little surface of bone opposed for repair. This is the commonest type is apt to come apart and fail to unite. It should be reduced and impacted.

Fig. 5. No better than the last mechanically and considered with regard to the chance of useful repair. More over the outward rotation is so great that there would be disability from it even with the bone solid. Such an impaction calls without question for remodeling and reimpaction.

on the felt protected trochanter. Presently a queer sensation of "giving" is felt and then a test shows the limb locked, toes standing up like those of a real leg. The limb no longer rolls loosely outward in one's hand! That is all! There is no damage not even superficial bruising. Impaction is probably never very deep, but it serves to hold position. The whole idea is to convert unfavorable into favorable types of fracture in shape for treatment.

In no sense can artificial impaction do more than this! In any case after treatment is the same as that used in the most favorable type of accidental impactions. That means rest—fixation.

I can accomplish this best with the double plaster spica with a crossbar,<sup>2</sup> that makes it possible to obtain fixation with a spica that may be cut away low down on the back and belly for the double abduction gives through abduction of the sound thigh, a fixation of the pelvis in relation to the damaged femur, and fixation of the trunk is not needed (Fig. 8). Moreover, this type of spica makes it possible to roll the patient on her face an hour a day without damage which helps lungs, circulation, and temper, and renders bed sores avoidable.

This fixation should be kept up from 10 to

<sup>2</sup>The single spica is fine at first while it fits. As the padding and the patient shrink there is considerable play and unless the spica is high and close enough to interfere with chest and abdomen fixation is no longer maintained.

12 weeks which is a safe average<sup>1</sup> At the end of this time in some patients usually the younger and more vigorous we find by X ray examination a union so solid that the patients are able to get along nicely with crutches only provided they are reasonably cautious.

This is not the rule however usually a convalescent splint is in order The reason for this is not only that repair is slow but also that there is interstitial absorption as noted above This phenomenon occurs in most cases is more marked in the older people but is not peculiar to them It seems akin to the softening in the cortical edges in lower leg fractures preceding or coincident with repair As a matter of fact whatever the treatment or non treatment this absorptive process goes on normally preceding or parallel with the repair process

At the hip absorption takes place at the expense of the living distal fragment which is supplied with blood and with nerve impulse which have been cut off from the broken off and so to speak deserted proximal fragment within the capsule Very often this absorption is extreme even in cases which ultimately unite by bone Evident at 4 weeks at its maximum usually at 6 weeks persistent for months thereafter particularly in the aged patients this process seems a part of normal repair (See Figs 24 25 37 38 39 40 41 42 43 44 45)

As a corollary of this presentation one must include a curious picture of slow repair after gradual or abrupt partial separation at the upper side of the line of fracture (See Figs 10 32 33 34 36) All these cases were carefully treated but all for no evident reason showed a tendency to fall apart None of them were even elderly patients none were infirm All protected achieved bony union late or later

One case a young man 'fell apart' entirely after 4 months' treatment by the Whitman method After reduction reimpaction fixation and later proper protection bony union was secured and the clinical result was marvelously good—100 per cent by any measure

Until recently this matter of absorption seems to have been overlooked by me as well as by others We cannot control it directly though I think that diathermy is of real use as I reported 2 years ago

With or without diathermy one may achieve results by protection In a case which shows absorption one fits a convalescent Thomas splint to the limb and then waits until the X ray shows that the splints may be discarded without risk

Figure 19 shows a patient who waited 14 months for a serviceable hip and got an admirable result Figure 33 shows a patient who waited 15 months and secured a 100 per cent perfect result In Figure 31 we see bony union which was obtained after protection for over a year and a quarter The patient in Figure 44 wore the splint for just a year and now has at 86 years a serviceable walking leg Another patient after 18 months has a clinically perfectly good hip with full function In this case the union is by a short fibrous bond not by bone but it works Another patient protected for 8 months has a serviceable hip solid with fair motion no pain The union is not bony Whether it may become bony or not I am not sure She is nearly 80 years old though vigorous

The moral is to use protection and to use it for months That means a convalescent Thomas caliper splint by day sandbags by night with massage and conservative passive motion to hip and knee at the morning and evening intervals

A chair to push before one or crutches should be used at first Later a cane or none should be used for the splint properly adjusted seems to be a definite protection against displacement

When the X ray shows that union is solid, bone solid then the splint is removed

The broad fact seems to be that if we correct fix and maintain in favorable position, any fracture within the capsule whether originally or artificially impacted maintain it until the X ray shows satisfactory repair then we are going to get a solid union bony more often than not but serviceable in any case

<sup>1</sup> For details see text. The patient mentioned was well better than most. The result was a happy one. The patient was not only able to walk but was able to do so without the use of crutches. The patient was able to do so without the use of crutches. The patient was able to do so without the use of crutches.

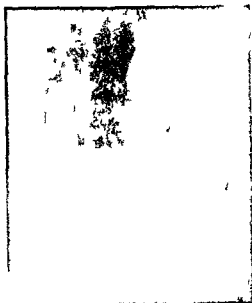


Fig 6 (left) X ray of case impacted for Dr Kellogg Speed Cook County Hospital Chicago January 15 1927 before reduction

Fig 7 Same case as in Figure 6 through the plaster after reduction and artificial impaction with the mallet

A certain mortality we cannot avoid, for most of the patients who have these injuries are infirm, elderly women. For like reasons we cannot avoid a certain proportion of arthritic complications, whether injury is in the hip or the knee.

What we can avoid is that ghastly class of "wheel chair invalids" with loose, sloshing non unions, unstable, and very painful, which have been the usual net result of hip fracture treatment throughout the country. We have all seen them!

And how may we avoid such results? In cases satisfactorily impacted, when we first see them, and there are only a few of them, we put up the limb and the patient in a double spica with a cross bar (Fig 8).

In this arrangement the patient can be turned over at least once a day, without pain and without damage. After 3 months this apparatus is exchanged for a carefully fitted Thomas caliper splint of the convalescent type, and the patient gets up, tries crutches, or gets about with a chair. From then on he uses the limb with caution and mobilization is allowed at hip and knee. Only the X-ray can tell us when to discard the protective splint. This is the treatment for the "ideal" (rare) case. For the less fortunate average case, one approximates this treatment artificially. The loose fracture must be corrected.

Under anaesthesia,<sup>1</sup> downward traction with the surgeon's stockinged heel is applied in the crotch until the length of the

<sup>1</sup>Not for 5 days in older patients. Heart, lungs, bowels, bladder are upset and at least this long is required for the patient to recover from the shock, and to adjust her bodily processes to a bed routine. This delay does not help the fracture, but is essential to the patient.

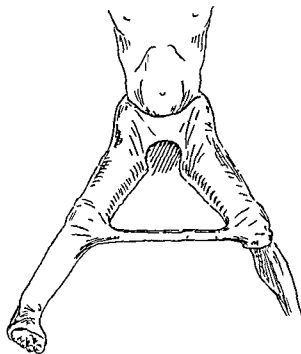


Fig 8 The double spica. The important thing is the cross bar of plaster 1 1/2 to 2 inches in diameter, solid enough to handle the patient, fracture plaster and all. Abduction of both thighs, internal rotation on the damaged side. Note the amount of freedom given to the abdomen as well as the chest.

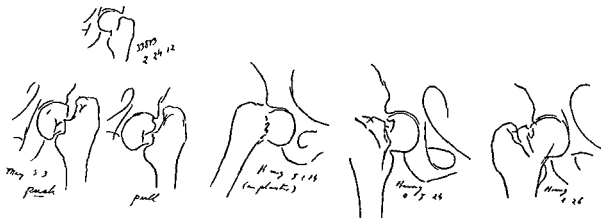


Fig 9 The absorption process. This patient left the hospital at 6 weeks apparently with solid union (X ray, February 24, 1912). Fifteen months later when I first got hold of him the condition was that of the push and pull pictures of May, 1913—a loose non union with hardly a trace left of the neck.

Fig 10 Partial absorption, slow union. A woman of 44 and vigorous. After reduction of a loose fracture and the usual impaction the condition looked favorable (see X ray of May 12, 1924). The spica was kept on 3 months. She

was out of bed at 4 months on crutches and beginning to walk. An X ray at 5 months taken as a routine showed the findings of the central tracing. Immediately I put on a convalescent Thomas caliper splint and there was no increase in the beginning separation at the upper end. She walked about on this splint actively without crutches but it was late in the summer of 1925 before I dared let her step without support. In the end the bone is solid (see the X ray of October 2, 1926) and function practically perfect.

limbs matches right and left. Then the leg is carried into moderate abduction, the limb is rotated inward while a stout assistant holds the pelvis steady from the opposite side. The operator, using a big heavy wooden mallet (5 to 8 pounds) strikes the padded trochanter a heavy slow, following blow inward. This

is repeated until the foot no longer rolls outward and impaction is obvious.

Then conditions are the same as if there had been in the first place an accidental impaction in good relation of fragments.

But if impaction is doubtful when the case is first seen, what then? An impaction as in

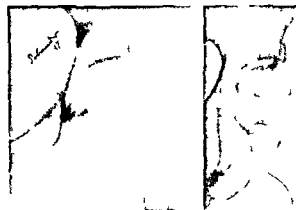


Fig 11

Fig 11 Union solid in 4 months in a woman of 68. A fortunate case of deep accidental impaction properly cared for. At the time of this X ray she was walking with out a cane.

Fig 12 A like case in a woman of 67. Impaction so exact that I did nothing but carry out routine fixation in spica, etc. No convalescent splint was used. Function



Fig 12



Fig 13

perfect 15 years later when this film was taken. This is the same patient whose other hip furnished Figure 14.

Fig 13 Loose fracture. Woman of 46, vigorous. Reduction, artificial impaction. Three months in spica. Convalescent splint to 6 months. X ray taken at 5 months. Solid, function nearly perfect but hip and knee are still somewhat stiff.



Fig 14



Fig 15



Fig 17



Fig 18



Fig 16

here shown was taken 2 years and 4 months after the date of my impaction. Function is literally perfect.

Fig. 16 Same case as in Figure 15. Hip re-reduced and impacted at 14 weeks. Result shown 28 months later. He is standing on the injured leg. There is (shown in Figure 15) a bit of *coxa vara* deformity, but it cannot be demonstrated clinically. Of course

some part of the result must be credited to his youth and vigor, but that did not seem to help while he was in the Whitman abduction spica.

Fig 17 Another late reduction and here in an elderly patient of 73, untreated for 7 weeks, with a loose fracture. Usual reduction and impaction and care. Absolutely perfect function. X-ray after 2 years.

Fig 18 The same patient just 2 years and a month later. No symptoms at all but a curious absorptive process in the solidly united but not fully nourished head. Because the patient has had infantile paralysis from childhood which has affected the other leg, this hip has to work pretty hard for its living.

Fig 14 Eleven years ago this patient, then 56 years old, had a loose fracture of the hip, which I reduced and impacted and treated according to my routine. After about 9 months she was back on full duty as a hospital superintendent and within a year had a perfectly normal hip without even limitation of motion. Ten years later she broke the other hip. (See Figure 12.)

Fig 15 The latest case of artificial impaction so far. Not seen by me until, on the removal of a Whitman plaster at 3 months, the whole thing fell apart. I saw him at 3½ months and, considering his age (then 28), decided to take a chance. Reduced fracture at 14 weeks after the injury and impacted. Then I followed my routine treatment. Plate

Figure 4 is useless and cannot hold under the inevitable absorption process. A position as in Figure 5 would not give a satisfactory result even if the fragments held and united.

In such cases, do not hesitate to "break up" an impaction, then reduce it, and re-impact with the big mallet. After this the technique of double spica etc., as described, is followed.

Artificial impaction, useful as it has proved to be, can do no more than give an initial fixation which corresponds to the more favorable types of accidental impaction. It gives no assurance, *per se*, of bony union. It has no influence on absorption of bone, or on repair.

After artificial impaction, one must fix the limb in the spica, must protect with splints,





Fig 9 The absorption pro  
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Fig 11

Fig 12 Union solid in 4 months in a  
A fortunate case of deep accidental impact  
cared for At the time of this X ray she was wal  
out a cane

Fig 12 A like case in a woman of 61 Impact  
exact that I did nothing but carry out routine fixation  
spica etc No convalescent splint was used Function



Fig 22

Fig 2 Woman of 58 years. Fracture was reduced impacted and protective splint later. She wore this too long due to getting lost in the Out Patient department. This X ray was taken nearly 2 years after injury. Function is nearly perfect. She has some habit lump but no serious loss of motion from the bony overgrowth.

Fig 23 Woman of 50 years. Patient had a loose fracture which was reduced impacted and the usual treatment followed. X ray shows result at 18 months. She has per-

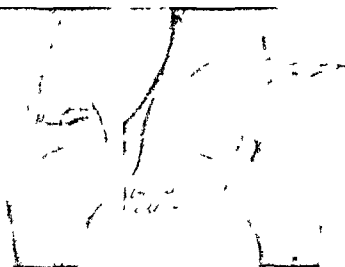


Fig 23

Fig 24

fect function with a little limitation of hip and of knee motion.

Fig 24 Woman of 52 years. She had a loose fracture which was reduced and impacted and the regular treatment followed. A convalescent splint was employed for 4 months after the spica. The roentgenogram at 10 months shows solid union but she has some pain. Also some disability largely due to an old fracture of the tibia into the knee of years ago.

very slowly with a good deal of absorption going on.

A good many patients would be surprised to find themselves in either of the last two classes, but the fact is that the women (and nearly all hip fractures are in women) who are now in their sixties and seventies are not good risks as fracture patients. They may have no definite lesions, but they have little muscle, less control, and very often, a rather inert habit of mind.

I am of those who believe that the present day "flapper" is a very great improvement on her grandmother. A hard little animal, stoic, trained away from emotion, she is going to make the treatment of senescent lesions a very much simpler problem for our successors of, let us say, 1960.

We can almost assure the old lady with a fractured hip that she will get bony union or at worst, under our routine, a short fibrous union, mechanically serviceable. In at least three fourths of the cases that come into our hands, bony union can be secured by the method described.

But, with such results as far as actual repair is concerned, the clinical results, measured in terms of use of the hip, are curiously

dependent on the age and type of the patient and on the kind of reaction she shows to convalescent conditions.

In the series to follow, there is a case of fracture in a youthful person of far past 80. She is as good as you or I, today, in body, mind, courage, and interest. Therefore she is going about with a hip not only solid but thoroughly useful to her. Repair has been slow, of course, because of her age, but healing is now complete and bone union seems to be complete.

The gathering together of these cases has been very instructive, at least to me. More clearly than before I see that age must be reckoned with, after 70 or 75 repair is not so good.

More important, practically, is the matter of convalescent splinting. Many years ago Newton Shaffer got a clinical cure in an old case by splinting in abduction. Bradford has reported cases successfully treated in ambulatory fashion with his abduction splint, a splint that no adult ever would put up with for anyone but dear old Dr. Bradford, but an efficient splint. Campbell, of Memphis, was the first to emphasize convalescent splinting to remain in place for a long period.



Fig 25



Fig 28



Fig 29

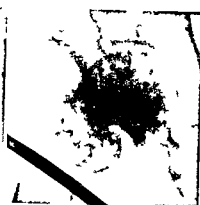


Fig 30

Fig 25 Fire captain of 63 years very vigorous had a loose hip fracture which was impacted after reduction. Usual routine treatment followed. Union was a bit slow. Protective splint was worn for 6 months after the plaster. X ray at 11 months from date of injury shows solid union. Function is good but flexion is still somewhat limited and arthritic stiffness of both knees is present. Now at 63 years he has retired from the department but is very active doing many miles of walking.

Fig 26 Loose hip

Fig 27 Same 8 months later after artificial impaction and usual routine

Fig 28 Woman aged 55 years when injured. This was 14 years ago. X ray was taken 13 years ago. This patient happens to be working for some of my family. Her activity is extraordinary, the hip function perfect.

Fig 29 Man of 54 suffered a loose fracture which was impacted with a mallet. Delayed union. Convalescent splint was worn for 14 months but he was active in this period using only a cane. X ray shows a bony union but apparently dotted with cartilaginous or fibrous areas. He has a slight limp when he hurries but no pain. Flexion two thirds.

Fig 30 Man in late sixties. Artificial impaction was applied followed by protective splinting. Here again is a patient who did not report back when told to therefore he remained too long in the splint. X ray at 10 months after injury showed solid union. Good function is present but limb is not supple.

Fig 31 Woman in mid sixties had a loose fracture. Artificial impaction but with delayed union. A splint was applied. Further delay from pneumonia. Slow union

Now solid and the limb useful but she is pretty stiff in movement.

Fig 32 Woman of 48 years. Again union was slow with a tendency to separation at the top. She was seen first in bed 2 weeks after removal of the spica. A Thomas convalescent splint was worn for a year. Union is now solid but she has limited motion of hip and knee.

Fig 33 Another case that tried to come apart. The X ray shows the end result, perfect function. Same case as that of the tracings in Figure 10.

Fig 34 Case of woman in mid fifties reduced for Dr Cushing at the Peter Bent Brigham hospital. Loose fracture here shown as of January 5, 1916.

Fig 35 Same case as in Figure 34 showing imperfect union at upper edge after removal of plaster May 1, 1916. Convalescent splint was worn.

Fig 36 Same case. Next year March 13, 1917. Excellent function. Solid union.

Fig 37 Another case of deliberate union. These are the cases that not checked up account for the bad end results in what seem promising cases. This patient was only 46 but was suffering from a bad myocardium etc. The fracture was loose, it was reduced and impacted but I did not get her for a fortnight after the injury. Thus the unreduced fracture.

Fig 38 Same patient as in Figure 37, 10 weeks later in plaster. Note the slight overcorrection into coxa valga. I like to do this when I can. (See Fig 13.)

Fig 39 Same patient as in Figure 37 at 7 months (in convalescent splint). Position perfect. Union apparently fibrous only. She was allowed to walk about a bit with and without the splint.

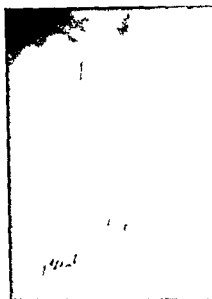


Fig 31



Fig 32



Fig 33

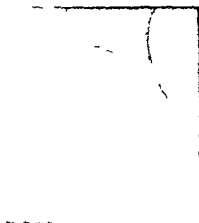


Fig 34

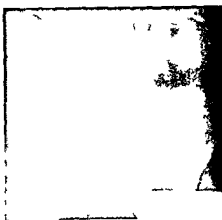


Fig 35

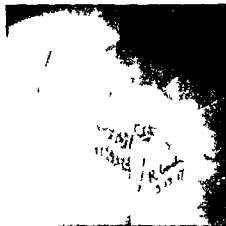


Fig 36



Fig 37

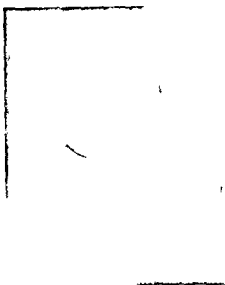


Fig 38



Fig 39

(Description on opposite page)



Fig 40

Fig 40 Same patient as in Figure 3 at 18 months. No question of the bony union now but note the extent of absorption of the neck after a solid fibrous union occurring later than 1 month after injury.

Fig 41 The kind of union one gets at 80 after absorption. A distorted break lightly impacted in extreme outward rotation. Reduced and impacted. Four months

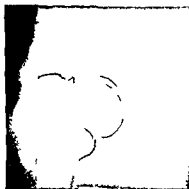


Fig 41

Lately I keep the splints on until the X ray shows it is safe to let the patient go without them.

Cases like those shown in Figures 32, 33 and 44 under any ordinary routine treatment would not have achieved union at all.



Fig 42

fixation and protection. Regained good function but with a limp.

Fig 42 Woman of 60 odd. Good reduction and impaction was secured but there was excessive absorption with delay in union. Apparently she was much helped by diathermy. Final complete union shown in X ray. Function good but motion limited; she has a limp.

A routine such as I now use is onerous enough to make one wish for the patient's sake for a better method. So far we have no better, no reasonably easy way of getting proved results. The only redeeming feature in this situation is that a convalescent Thomas splint



Fig 43

Fig 43 Woman of 79. For years she was a sufferer from hypertension. Fracture was reduced, impacted, a spica applied later a convalescent frame splint then the walking Thomas splint. This film was taken at 14 months. She walks without splint or cane and with very little limp but some stiffness. She can do everything but get out of her chair alone.



Fig 44

Fig 44 Patient 86 years old, double pneumonia during convalescence. Usual routine except for this. This

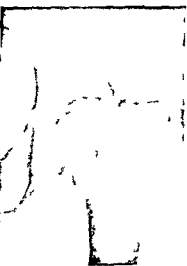


Fig 45

X ray was taken at 13 months. She goes about with a cane, can travel stairs, not easily, and has a little trouble in sitting. Union is solid and I think bony. Note the grade of arteriosclerosis of femora and profunda as indicated by the crosses.

Fig 45 Woman of 77. Usual treatment. Union is solid but there has been extreme absorption and mechanically there is some limitation of flexion and of abduction. She is however very active now in Italy for the season.

adequately fitted, is not so great a nuisance as one would think.

Very lately, the scheme of spiking hip fractures and allowing early motion has been revived. Possibly the development of a better technique in spiking may get good results, but those of us who used the method many years ago, and have watched their own results as well as those of others, are a bit skeptical. Follow up reports are a bit scarce and a bit recent, and there are already failures.

Nevertheless, if any available technique will give real fixation, with a chance of early motion, and at the same time without hindering—then, of course, we want to use that method in all cases fit for operative handling. The latest question is whether fixation by artificial impaction (no spike) may perhaps allow earlier application of a convalescent

splint and diathermy. I do not yet know. There is no question but that early function *per se* promotes union. The only question is whether early function is consistent with real fixation, or only with a wobble. Wobble between fragments (even a little wobble) is what ruins our results, it seems.

So far as we have gone, it seems that Campbell's cases—an admirable series—, a list not yet published from the Massachusetts General Hospital, and these cases here presented, are the only data resting on any great amount of grouped data that give any idea as to what we can do with fractured hips.

As to "artificial impaction," please understand that I claim only that this method puts the limb in shape for the proper and successful treatment for satisfactorily impacted fracture.

This much it has done,—and will do.



Fig 40

Fig 40 Same patient as in Figure 3 at 18 months. No question of the bony union now but note the extent of absorption of the neck after a solid fibrous union occurring later than 7 months after injury.

Fig 41 The kind of union one gets at 80 after absorption. A distorted break, lightly impacted in extreme outward rotation. Reduced and impacted. Four months

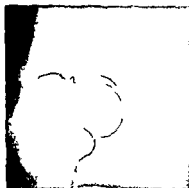


Fig 41



Fig 42

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Fig 43



Fig 44

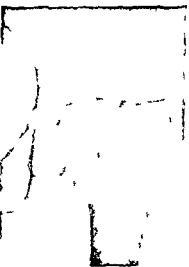


Fig 45

Fig 43 Woman of 9. For years she was a sufferer from hypertension. Fracture was reduced, impacted, a spica applied, later a convalescent frame splint, then the walking Thomas splint. This film was taken at 14 months. She walks without splint or cane and with very little limp but some stiffness. She can do everything but get out of her chair alone.

Fig 44 Patient 86 years old, double pneumonia during convalescence. Usual routine except for this. This

X-ray was taken at 13 months. She goes about with a cane, can travel stairs not easily and has a little trouble in sitting. Union is solid and I think bony. Note the grade of arteriosclerosis of femora and profunda as indicated by the crosses.

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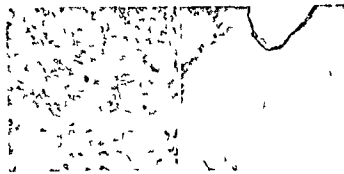


Fig 1

Fig 1 Case 1 Photomicrograph of primary lesion in base of tongue. The tumor cells are indistinct and diffusely scattered in the lymphoid stroma.

Fig 2 Case 1 Healed ulcer at base of tongue previously the seat of transitional cell carcinoma completely destroyed by radiation. Patient died of visceral metastases. Specimen obtained at autopsy.

Fig 3 Case 1 Photomicrograph of lesion at base of tongue showing cellular scar tissue fully covered by

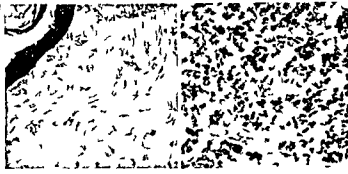


Fig 3

squamous epithelium with no signs of carcinoma. This site was previously the seat of transitional cell carcinoma as proved by biopsy.

Fig 4 Case 1 Photomicrograph of metastatic nodule which was located in the liver and which was a metastasis from the transitional cell carcinoma primary in the base of tongue. The tumor is a very cellular round and polyhedral cell highly anaplastic carcinoma in which squamous characters are entirely lacking.

either that they arise from transitional epithelial cells which are known to be present in locations where these tumors most commonly arise or that they spring from squamous cells which lose their epithelial characters and assume anaplastic features. Both clinical and pathological evidence indicate that their origin is probably from deep rather than superficial structures.

Histologically the cells are small uniform in size with a relatively large hyperchromatic nucleus and scanty cytoplasm. They are closely packed with little intercellular substance. The cells sometimes form solid groups sometimes they grow in anastomosing columns of opaque granular polyhedral cells with convolutions. Flat pavement characters, spines, hornification and pearl formation are regularly absent. These structural characteristics are maintained in the metastatic cervical lymph nodes and distant visceral metastases.

Although it has been observed that occasionally metastases from squamous carcinoma may lose their adult epithelial characters and display anaplastic features this phenomenon is a rare exception. Generally squamous carcinoma tends to maintain its structure rather rigidly so that hornification, spines and pearl formation are often observed in the local and distant metastases as well as in the primary tumor. In metastatic nodules in the liver extensive hornification and spine

formation are observed. Histological studies of a series of intra oral carcinoma revealed that the cell structure of the primary lesion as shown by biopsy was maintained rigidly throughout, in the lymph nodes and visceral metastases.

Whereas the histological features and many of the clinical peculiarities of these tumors have been observed, their unusual susceptibility to radiation has not been pointed out. Deep carcinoma of the tongue have been observed to regress under roentgen therapy alone. Advanced tonsillar carcinoma with metastatic cervical nodes have been observed to show unusual regression after radiation. The explanation of these phenomena has not been clear. In view of what has been said it is evident that in these cases the tumor process has not been of the squamous type, but of the radiosensitive transitional form and the striking regression in response to small doses of radiation may be explained on this basis. The fact that these paradoxical results have occurred in the same anatomical locations where the transitional cell has been found to be most common, namely, the tonsil, base of tongue, and nasopharynx, is further evidence that this explanation is probably correct.

In a group of irradiated cervical lymph nodes recently described by the authors, many instances of marked response to radiation were observed following relatively small doses. An investigation of the type and structure of the





Fig 5



Fig 6

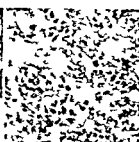


Fig 1

Fig 5 Case 1 Biopsy specimen from transitional cell carcinoma of tonsil. Tumor in primary lesion and metastatic cervical nodes completely destroyed by external radiation. Patient died of visceral metastases. Note mitotic figures.

Fig 6 Case 2 Photomicrograph showing complete destruction of transitional cell carcinoma in cervical lymph node following external radiation. The darkly stained nuclei are remaining lymphocytes.

Fig 1 Case 1 Gross specimen of cervical lymph node after external radiation showing complete necrosis of tumor tissue (see Figs 5 and 6). Primary lesion in tonsil.

cell as revealed by biopsy taken from the primary lesion soon revealed that in these cases we were dealing with a cell devoid of squamous characters and showing lack of differentiation. Differences in the mode of regression of the transitional cell and squamous carcinoma were pointed out. Rapid and massive liquefaction necrosis associated with a rich exudation of lymphocytes and plasma cells are characteristic effects of radiation upon the transitional cell tumor.

The infrequency of internal metastases from intra-oral carcinomata is well known. In Crile's series it was noted in only 1 per cent of the cases. Because of the undifferentiated quality and loose structure of transitional epithelium it is reasonable to suppose that it would metastasize earlier and more widely than the squamous cell. Metastasis is undoubtedly favored by an atypical structure and by an origin from deep rather than superficial structures.

A close study of 2 cases of transitional cell carcinoma presented the opportunity to collect important data bearing on this point and served to confirm the above impressions. Complete autopsy of 1 case and an exploratory laparotomy of the other demonstrated bulky internal metastases in both. Two other cases are reported in detail to point out other characteristic features in the clinical course of the disease.

CASE 1. H. A. male aged 57 November 1914 developed a swelling of the right side of the neck

which progressed for a period of 2 to 3 months under the diagnosis of chronic lymphadenitis. The family and past histories were negative. In February 1925 a dissection of the right neck was done and an infiltrating epidermoid carcinoma found on section. Thorough exploration of the pharynx, nares, larynx, oesophagus and tongue failed to disclose any primary lesion and there were no localizing symptoms. A diagnosis of branchiogenic carcinoma was made. About the same time a slight induration was suspected at the base of the tongue and a liberal piece of tissue was removed which failed to show any trace of carcinoma. In April 1925 a second operation was done: all the nodes of the right side of the neck being completely dissected but no trace of carcinoma was found in any of the tissues. About July 1925 there was slight bleeding and pain at the base of the tongue and a section was taken which for the first time disclosed the primary lesion: a transitional cell epidermoid carcinoma (Fig 1). At the same time an enlarged node appeared on the left side of the neck about 2 centimeters in diameter. Examination of the lesion at the base of the tongue (July 1925) revealed a circumscribed ulcerated new growth involving the base of the tongue on the right side. On July 3 1926 6 gold tubes (0 millimeter filtration) each 2.71 millicuries were implanted into the tongue lesion (total 2151 millicurie hours). Following the radiation there was very satisfactory regression of the primary lesion as well as the metastatic node and the general condition improved. In November 1925 the lesion in the tongue was completely healed; there was however a soft swelling present above and below the right clavicle but no definite mass. There was no mediastinal shadow on X-ray and the lungs were negative. From this time on the patient's general condition became worse: he developed a marked anorexia and nausea but no vomiting; also some abdominal pain referred to the upper right quadrant. Examination at this



Fig 8

Fig 9

Fig 10

Fig 8 Photomicrograph showing early invasion of lymphatics by transitional cell carcinoma in a nasal growth mistaken clinically for a nasal polyp. The patient was a young girl aged 24. This process probably accounts for the early lymph node involvement in these cases.

Fig 9 Case 4 Photomicrograph of transitional carcinoma of larynx. The lesion was considered so far advanced that only surface radiation was employed as a palliative measure. The lesion responded rapidly and cleared up entirely. The patient is entirely free of disease after almost 2 years.

Fig 10 Case 4 High power of biopsy specimen. Note mitotic figures.

time revealed a moderate degree of tenderness over the region of the liver and an indistinct mass, probably an enlarged liver. The patient's condition grew worse, the mass continued to increase in size, he developed moderate ascites and later jaundice of the skin and sclera; also petechial hemorrhages and he died on May 11, 1926.

At autopsy, the hepatic flexure of the colon was firmly bound to the liver by dense adhesions. The liver was enormously enlarged, the right lobe was occupied by three large tumor masses soft and hemorrhagic. One appeared as a cyst lined by tumor tissue and filled with recent blood clot. At the base of the tongue there was a healed scar with no gross signs of carcinoma on section (Figs 2 and 3). Microscopic examination of the lesion at the base of the tongue showed cellular scar tissue with no signs of carcinoma. The tumor in the liver was a very cellular, round and polyhedral cell, highly anaplastic carcinoma (Fig 4).

CASE 2 J. S., male, aged 45 developed an enlarged node in the left side of his neck 5 months before admission. Four months after the node was detected he experienced slight pain in his throat on swallowing. Examination revealed a movable node 2 by 3 centimeters in the upper right cervical chain and a deeply infiltrating neoplasm involving the right tonsil. A biopsy specimen taken from the tonsil showed a transitional cell epidermoid carcinoma (Fig 5). The primary lesion was treated with gold radon implants and the cervical nodes with high voltage X-ray and the radium pack. Both responded favorably to radiation, the primary lesion healed without sloughing and the cervical node decreased markedly in size. Two weeks later the cervical node was removed (Fig 7). On histological examination there was complete destruction of the tumor with a few scattered foci in which shadows of epidermoid carcinoma could be made

out (Fig 6). The patient's general condition improved and for 1 year and 4 months there was no evidence of disease locally or generally. Sixteen months after the patient was first seen he presented himself in a weakened condition from intestinal obstruction. A laparotomy was performed and a tumor mass found in the lower dorsal and upper lumbar region obstructing the splenic flexure. The patient died 2 months later. No autopsy was obtained.

An analysis of the inception, clinical course, mode of termination, and pathology of these 2 cases makes it obvious that we are dealing here with a condition which differs markedly from the routine squamous cell carcinoma of intra oral origin. Furthermore, these cases present a striking similarity in their clinical course and pathological findings. In both cases the site of the primary lesion was the tonsil and base of the tongue. In both, the first manifestations of the disease were in the cervical nodes. In Case 2, 4 months elapsed and in Case 1, 8 months elapsed between the first appearance of nodes and the discovery of the primary lesion, in spite of the fact that in Case 1, the patient was under competent medical observation from the time the nodes first appeared. The susceptibility of the lesion to radiation was so marked that in both cases the primary lesion and metastatic cervical nodes were rendered entirely free of the disease as proved by histological examination differing in this

very important way from the resistant squamous cell carcinoma. The comparatively early and wide dissemination of the disease with bulky visceral metastasis and rapidly fatal course further differentiates these cases from the slowly growing squamous cell lesion. Associated with these characteristic clinical features is encountered a specific histological structure to which the term transitional cell epidermoid carcinoma has been applied.

CASE 3. N. G. male aged 50. In February 1923 patient experienced difficulty in breathing and about the same time noticed a small lump on each side of the neck. The growth on the right side remained stationary and that on the left increased in size. Examination on admission revealed a mass of enlarged nodes in each upper cervical region. There was a swelling on the posterolateral wall of the pharynx on each side just behind the tonsillar pillar. A diagnosis of lymphosarcoma of the neck was made. X-ray films of the chest revealed definite evidence of mediastinal involvement. Following radiation the mass on the left side of the neck was removed. In view of the apparent absence of a primary lesion a diagnosis of branchiogenic carcinoma was made. About the same time a suspicious lesion was noted on the posterior pharyngeal wall and a biopsy specimen taken. The pathological report on this tissue was squamous carcinoma. (At that time the distinction between squamous and transitional cell carcinoma had not yet been made.) One week later the mass of nodes on the opposite side of the neck was removed and a similar pathological report obtained. In January 1926 the patient was admitted to another hospital with local recurrences in the neck. The mass on the left side was removed and gold radon seeds were implanted on the right side. Several days later he suddenly became dyspnoeic and cyanotic and died within a few hours. An autopsy was not obtained.

The clinical course of this case presents several interesting features. In the first place the picture was dominated by the metastatic process while the primary lesion remained unrecognized consequently a diagnosis of lymphosarcoma of the neck was made. After histological examination of the cervical nodes had revealed an epidermoid carcinoma a clinical diagnosis of branchiogenic carcinoma was made and the original diagnosis of lymphosarcoma abandoned. Three months later the patient developed a suspicious lesion on the posterior pharyngeal wall near the tonsillar pillar which for the first time re-

vealed the seat of the primary lesion. This case is cited to point out the peculiar course of the disease and to emphasize the importance of excluding a primary intra oral lesion before interpreting enlarged nodes as primary in origin.

CASE 4. F. C. male aged 59 in April 1925 first noticed slight hoarseness associated with some soreness of the throat and a slight cough. On several occasions he coughed up bloody sputum. His general health remained good and there was no loss of weight. Examination revealed a granular ulcerated lesion on the right anterior surface of the epiglottis near the base extending onto the anterior part of the right vocal cord. In the right side of the neck underlying the sternomastoid was a firm movable node 2.5 centimeters in diameter. Examination of a biopsy specimen from the primary lesion revealed a transitional cell epidermoid carcinoma. The case was considered too far advanced to attempt curative treatment consequently it was decided to perform a tracheotomy and resort to surface radiation as a palliative measure. Table I shows the radiation employed.

TABLE I—RADIATION EMPLOYED IN CASE 4

R d m						
D t	M l l h u	A a C m	F l t r	D t C m	A p p l c t	L o c a t
6	500	4X5	2 mm B r s	3	T a y	R g h t d f l y n
176	50	4X5	2 mm B	3	T a y	L e f t d f l y n
286		8X	mm B s	6	P k	R g h t d e f n k
296	00	8X1	mm B	6	P a c k	L e f t t f n k

X y					
D t e	T m n t e s	V l t e (peak) l t	F l t r	T a t n e C m	V
526	6		0.5 mm C 1.0 mm Al	5	4
76	60	00	5 mm C 0 m Al	5	4

T h t d m p a c k t m l l c h n t 6 t m t d s  
 t i p p r s m a t l y p e t o f e v t h m d f t h r d m  
 t y t a c n t m t d t e s m l l s e h i s p r m t i y  
 o p e r c t o f a n e y t h m a d o s  
 S t y m t e f h g h v l t g X a y w t h t h a c t g  
 p p r m a t e l y 85 p e r c e n t o f a e r y t h e m d i s e

Following radiation there was marked regression of the primary lesion and cervical node. Laryngoscopic examination showed marked radium effect and no evidence of disease. The primary lesion having entirely disappeared. The last examination made on July 20 1927 revealed no evidence of di-

ease in the larynx and complete regression of the cervical node

This is a very remarkable case in that the primary lesion has apparently completely disappeared under moderate external radiation alone. At the present time, 2 years and 3 months after the beginning of symptoms there is no evidence of disease locally or generally and the general condition of the patient is excellent. Although the time is still too short to predict the ultimate fate of this patient, the result up to date is very remarkable in view of the nature of the lesion and the advanced condition of the growth. The case furthermore points to the possibilities in the treatment of this type of lesion by external radiation alone.

#### ADDITIONAL CASES

CASE 5 J H male age 50 was first seen in the out patient department of the Memorial Hospital, May 6, 1924 with the history that 3 years ago he was struck by a hand ball in the side of the neck, and on the following day noticed a swelling in this region which had been gradually increasing in size. In May 1923 this mass was removed and was followed by a local recurrence in the scar. Examination at this time showed no evidence of a primary tumor and a diagnosis of bronchiogenic carcinoma was made. In November 1924 the patient developed bleeding from the left nostril. Examination at this time disclosed a discoid mass  $1\frac{1}{2}$  centimeters in diameter in the left nasopharynx just above the orifice of the eustachian tube. A biopsy specimen taken from this lesion revealed a papillary epidermoid carcinoma transitional cell type. The primary lesion was treated with bare tubes and the cervical nodes with high voltage X rays and radium packs. A specimen of tumor tissue removed from the left maxillary antrum showed transitional cell carcinoma. The patient was last seen in June, 1926. At this time the tumor mass was filling the left temporal region pushing the eye forward. His general condition was fair.

CASE 6 W J B male age 61, was admitted in December, 1924 with the history that 6 months ago he noticed a swelling in the right side of the neck. He paid no attention to this until 4 weeks ago when he began to notice difficulty in swallowing. His general health has been excellent. Examination revealed two firm enlarged nodes in the right side of the neck, both freely movable. Direct examination of the larynx showed a bulky growth about 3 centimeters in diameter lying in the pyriform sinus. Five bare tubes 51 millicuries each were implanted in the primary growth (total 673 millicurie hours). Following heavy external radiation with high voltage X rays and the radium pack a right neck dissection was performed. Examination of the tissue showed a transitional cell epidermoid carcinoma with marked radiation changes. At the present time the patient's general condition is excellent and there is no evidence of disease locally.

CASE 7 A I, male, age 48, was admitted May 9, 1924 with the complaint that about 6 weeks ago he noticed a sore on the left side of the tongue. Examination showed an ulcerated area on the left border of the tongue extending toward the base. The cervical nodes were not involved. Bare tubes were implanted into the primary growth and external radiation was applied to the neck after which a neck dissection was performed. Examination of the tissue revealed transitional cell epidermoid carcinoma with marked radiation changes. At the last examination on May 27, 1926 there was no evidence of disease.

CASE 8 N L, male, age 58, was admitted June 10, 1924, with the history that 3 months ago he developed hoarseness which has been gradually growing worse. Swallowing has also been somewhat painful. Two weeks before admission a cervical node was removed for diagnosis and a report of squamous carcinoma returned. Examination revealed a bulky extrinsic lesion involving the right pyriform sinus of the larynx and extending upward to the base of the epiglottis. There was a questionable node in the left neck. Bare tubes were implanted into the primary lesion and radium packs applied to the neck after which a left neck dissection was performed. Examination of the tissue revealed a transitional cell epidermoid carcinoma with marked radiation changes. The patient was last seen in the clinic in July 1924. At this time there was no evidence of disease. The patient has since been lost track of.

CASE 9 M S male, age 50 was admitted in July, 1924 with the history that 6 weeks ago he discovered a lump in the left side of the neck which has gradually increased in size. Three weeks ago he noted for the first time a sore on the side of his tongue. Examination revealed a very extensive lesion involving the left base of the tongue extending up onto the soft palate and involving the uvula and the tonsillar pillar. There was also a hard movable node in the left upper deep cervical chain. Treatment consisted in the implantation of bare tubes in the primary lesion and heavy external radiation to the neck followed by bilateral neck dissections. Examination of the tissue revealed a transitional cell carcinoma. The patient's general condition gradually became worse and he died in April 1925.

CASE 10 M A female age 48, in January 1924 began to experience difficulty in breathing. Four months ago she developed pain in the left forehead and about the same time noticed a small lump in the left side of the neck. Examination revealed a growth in the ethmoid with marked swelling extending down to the tonsillar pillar. There was also a fixation of the larynx with edema extending down to the pharynx. Treatment consisted in the implantation of platinum needles in the primary growth and heavy external radiation to the neck followed by a neck dissection. The pathological report was "transitional cell epidermoid carcinoma."



CASE 17 E C, male age 67 was admitted April 1924 with the history that 3 months ago he first noticed a discomfort in the throat followed by moderate hemorrhage. One week ago he discovered a lump in the neck which gradually increased in size. Examination revealed a deeply excavated ulcer which had destroyed the entire tonsil and involved the soft palate and lateral wall of the pharynx. A biopsy specimen revealed a transitional cell carcinoma. Treatment consisted in the implantation of bare tubes into the primary lesion and exposure of the neck to the high voltage X rays followed by a left neck dissection. At first there was an improvement in the general condition of the patient, but later he declined rapidly and died in December, 1924.

CASE 18 A D, male age 26, was admitted March, 1923 with the history that in November 1922 he developed a sore throat. In December, 1923, this was treated with the cautery with no improvement. For the past several weeks he has had 4 attacks of hemorrhage from the throat. Examination revealed a very bulky growth involving the entire tonsillar region and base of tongue. There was a large firm node at the angle of the jaw on either side. A biopsy specimen revealed an epidermoid carcinoma, transitional cell type. Treatment consisted in the implantation of bare tubes into the primary lesion and the application of high voltage X ray to the neck. At first there was satisfactory regression of the lesion, later, however there was local recurrence of the disease, the general health of the patient grew worse, and he died in January 1925.

CASE 19 W T O, male, age 73, was admitted September 1924, with the history that in March 1924 he felt a small sore on the inside of the left upper jaw which gradually increased in size and finally ulcerated. He consulted a physician who gave him X ray treatments over a period of 4 months. Examination revealed an extensive ulcerated lesion on the upper left alveolar ridge involving the mucosa of the cheek, anteriorly and laterally. There was a hard movable node 2 centimeters in diameter in the left submaxillary region. A biopsy specimen revealed a transitional cell epidermoid carcinoma. Treatment consisted in the implantation of bare tubes into the primary lesion and application of high voltage X ray to both sides of the neck followed by a left neck dissection. There was satisfactory regression of the primary tumor and nodes following radiation. At the last examination the patient's general condition was fair, but there was some evidence of local recurrence of the disease.

CASE 20 D D, male, age 49, admitted November, 1922 with the history that 1 year before he noticed a small lump on the left side of his neck which has been gradually increasing in size. He felt nothing inside his throat until about 3 months ago, when he began to have difficulty in swallowing. Examination revealed a deeply infiltrating neoplasm involving the anterior pillar of the left tonsil

and an enlarged node in the left anterior cervical region. The local lesion was treated with bare tubes and the nodes in the neck exposed to the radium pack after which a neck dissection was performed. Examination of the nodes revealed a very cellular epidermoid carcinoma, transitional cell type with focal destruction of tumor cells. There was marked regression of the tumor under radiation. The patient's general condition improved at first but later became worse. He died January 14, 1924.

#### CLINICAL ANALYSIS

Based upon histological examination of sections obtained from biopsy specimens and metastatic lymph nodes, 20 cases of transitional cell epidermoid carcinoma were selected and a study of the clinical history and course of the disease made with the view of determining any specific or characteristic features which might be associated with this particular type of cell growth. A special attempt was made to determine the presence of any features sufficiently constant and characteristic to permit clinical recognition of the nature of the lesion. The results of this study demonstrated four outstanding features which may be regarded as more or less characteristic:

1. *Location of the lesion.* Of 20 cases analyzed the distribution of the primary lesion was as follows:

	Cases
Tonsil	10
Base of tongue	3
Larynx	4
Nasopharynx	2
Mucosa of cheek	1
Total	20

In several cases listed in the tonsil group it was impossible to determine whether the tonsil or base of tongue was the seat of the primary focus is the lesion when first seen had involved both regions. In a number of cases belonging to this group, the primary seat of the lesion was in the nares. In one case the condition was regarded as a benign polyp and the tumor excised locally. Because of the fact that complete data is lacking in these cases they are not included in this report. It is important, however, to recognize the nasopharynx as one of the favorite

sites of occurrence of this type of growth. It may be stated that the lesion is most common in the tonsil base of tongue and nasopharynx. The 14 cases of transitional cell lesions of the tonsil and base of tongue were selected from a group of 148 tonsillar and lingual carcinomata. These figures indicate the relative proportion of the squamous cell and transitional cell in these particular locations. Although these data are based upon a relatively small group of cases yet we believe it is sufficient to point to the tonsil base of tongue and nasopharynx as the favorite sites for this lesion. The evidence presented by this group of cases is substantiated by the clinical experience that not infrequently carcinomata of the tonsil base of tongue and nares have been observed to show a phenomenal response to radiation. The explanation for the frequency of the transitional cell in these particular locations is not clear.

2 *Gross appearance of the lesion.* The appearance of the primary lesion is more or less characteristic and since attention has been directed to these growths certain features have been observed which give them an appearance differing from that of a primary squamous cell lesion. Squamous carcinoma usually presents a coarsely granular appearance which progresses to frank ulceration. The lesion typically has an elevated indurated border with a depressed ulcerated crater. Contrasted to this the transitional cell lesion presents a finely granular velvety surface which looks like an erosion of the mucous membrane rather than a frank ulceration. The lesion is flatter and gives the impression of having originated in the deeper structures and adhered to and eroded the mucous membrane from beneath. In a number of instances the gross appearance of the lesion has given an accurate clue to the diagnosis of transitional cell carcinoma.

3 *Clinical course.* Case 1 presents an unusual opportunity to study the clinical course of a typical transitional cell lesion. The first sign of disease was the appearance of a swelling of the right neck which for 2 or 3 months progressed under the diagnosis of chronic lymphadenitis. Removal of the mass revealed an epidermoid carcinoma and since

very thorough exploration of the pharynx larynx nares and oesophagus failed to disclose a primary lesion a diagnosis of branchiogenic carcinoma was made. Not until 8 months after the appearance of the cervical swelling was the primary lesion found. Pain and slight bleeding pointed to the base of the tongue as the seat of the primary lesion and a biopsy specimen supplied the diagnosis. The logical explanation for the course of events in this case would be that we are dealing with a deep seated very cellular lesion having its origin at the base of the tongue. The cell being of a type which metastasizes early and grows rapidly the disease becomes evident as a metastatic focus before the deep primary lesion approaches the surface and ulcerates. In the meantime the clinical picture is dominated by the metastatic phenomena and the case proceeds under the wrong diagnosis of chronic lymphadenitis branchiogenic carcinoma or endothelioma until the primary lesion ulcerates and produces symptoms.

Analysis of the clinical histories and course of the group of 20 cases revealed the interesting fact that in 13 of the cases the patients gave a history of having noted the presence of enlarged nodes in the neck as the first sign of disease before any abnormality referable to the intra oral region was detected and in 2 cases the cervical swelling and primary lesion became evident simultaneously. In 5 of the 20 cases thorough search failed to reveal a primary lesion and the cases progressed under the diagnosis of branchiogenic carcinoma endothelioma lymphosarcoma and reticulum cell sarcoma until at a later date the primary intra oral lesion became evident and the correct diagnosis could be made.

The course of events in these cases is similar to that found by other investigators in tumors which fall in this group. In a very careful and detailed study of carcinomata of the nasopharynx Crowe and Baylor state that the first sign of carcinoma in this region is often a painless and rapid increase in size of the deep cervical glands at the angles of the jaw. Of 79 cases of carcinoma of the nasopharynx reported by New 51 had enlarged cervical nodes. Eighteen of the 51

patients in whom the cervical nodes were involved had had operations on the neck without discovery of the primary tumor. A microscopic diagnosis of endothelioma from the node removed had been made elsewhere in 3 cases.

**4 Response to radiation** The marked radiosensitivity of the transitional cell carcinoma constitutes one of its most important properties and differentiates it from the radioresistant squamous cell carcinoma. The difference in the radiosensitivity of these two types of cell is so marked that the response to radiation may give a clue to the nature of the condition. The response of the primary lesion and the metastatic nodes has been so marked that in many instances microscopic examination revealed complete destruction of all tumor tissue. From a therapeutic standpoint these differences assume considerable importance. The amount and type of radiation necessary to destroy the tumor process is obviously different for the two types of cell and the principles underlying radiation treatment of the squamous cell and transitional cell are undoubtedly not the same. Destruction of the squamous cell must occur through an intense effect from interstitial radiation or by very heavy external radiation whereas complete destruction of the transitional cell tumor may be accomplished in many instances with relatively small doses of external radiation.

#### DIAGNOSIS

The diagnosis of this condition should be based upon the clinical pathological picture rather than on the histology or clinical features alone. Whereas, in certain cases the histological features are so typical that a diagnosis may be made on section alone, many instances occur in which the resemblance to other conditions is so marked that the microscopic picture should be considered only in conjunction with the clinical data in order to reach a proper interpretation of the case. In some cases the clinical features have been so characteristic that the proper diagnosis has been reached clinically and confirmed by section. The favorite site of the lesion (tonsil, base of tongue, and nares), its

early metastasis, wide dissemination and rapid response to radiation are the predominant clinical features. The absence of squamous characters—hornification, spines, and pearl formation—differentiates the two conditions histologically.

Branchiogenetic carcinoma is differentiated by its histological structure, slow rate of growth, lack of response to radiation, and absence of a primary lesion. It is probably always squamous.

Primary endothelioma of lymph nodes may resemble transitional cell carcinoma in which the nodes are enlarged and primary lesion undetected. This condition was described by Chambard in 1880 under the term "primary carcinoma." Since then detailed reports of the gross anatomy, microscopic structure and clinical course have been furnished by Ewing and the disease is now generally regarded as a distinct entity. This disease is comparatively rare, commonly arises on the basis of a chronic granulomatous inflammation, especially tuberculosis, and is often classed as secondary carcinoma. The disease may occur as a systemic involvement of many lymph nodes or as single or multiple tumors of cervical, axillary, or other lymphatic chains. The localized tumors are commonly regarded as tuberculosis. The history of an antecedent tuberculous infection, the slower progress of the disease, the lack of response to radiation, and the persistent failure to find a primary intra oral lesion are differential points in favor of endothelioma. A more rapid clinical course and a favorable response to radiation are in favor of secondary carcinoma. The detection of a primary intra oral lesion establishes the diagnosis.

#### TREATMENT

Because of the marked radiosensitivity of the tumor on the one hand and its high grade of malignancy on the other, there is no question but that this lesion should be treated by radiotherapy. The very poor surgical results of highly malignant anaplastic tumors is only too well known. The inaccessibility of the primary lesion makes it difficult of surgical approach and complete removal. The primary lesion has been treated by buried gold



radon implants distributed as uniformly as possible throughout the growth. The results of the treatment of the primary lesion have been satisfactory in most cases. In many instances there has been complete regression of the disease frequently without gross necrosis of tissues. The treatment of the metastatic cervical nodes has consisted of radiation with high voltage X rays and radium followed in most cases by neck dissections. Examination of the radiated specimens has shown in many instances complete destruction and devitalization of all tumor cells.

The ability to cure completely for the primary lesion and metastatic cervical nodes by radiation has been demonstrated. The danger lies in the early dissemination of the disease to the viscera so that whereas the primary lesion and cervical nodes have been cared for the patient returns with bulky visceral metastases. There are three possible explanations for this course of events: (1) The disease in the primary lesion or cervical nodes has not been completely destroyed, (2) the disease was disseminated by operative trauma or (3) distant metastases were present though not demonstrable when the patient presented himself for treatment.

Our data indicate that the disease can be completely eradicated from the primary focus and cervical nodes. The lack of differentiation of the cell, its high grade of malignancy and clinical evidence of early lymph node involvement favor the view that when the cervical nodes are already involved distant metastatic foci are also present which do not become evident clinically until later. The danger of dissemination of a very cellular tumor by operative trauma is undoubtedly great and merits serious consideration.

#### RESULTS

Results obtained in the treatment of the cases included in this study are given in Table II below. Thirteen of the 20 patients treated are dead. Of the 7 patients alive the interval is too short to designate any as cured. The unfavorable results obtained in the treatment of this group of cases as compared with the squamous cell carcinoma points to this lesion as the more malignant process.

TABLE II—RESULTS IN 20 CASES

Case	Living	Died
1		18 months
2		18 months
3		3 years
4	2 years 3 months	
5	3 years (local recurrence)	
6	2 years	
7	2 years	
8		4 months
9		12 months
10		3 months
11		6 months
12		18 months
13		4 months
14	2 years 6 months	
15	2 years	
16		16 months
17		12 months
18		2 years
19	2 years 6 months	
20		2 years

#### CONCLUSIONS

1. Within the group of intra-oral epidermoid carcinomata are found peculiar tumors presenting a specific histological structure to which the name 'transitional cell epidermoid carcinoma' has been applied.

2. Transitional cell carcinoma is a highly cellular malignant tumor. The cells are small uniform in size with large hyperchromatic nuclei and scanty cytoplasm growing diffusely, sometimes forming solid cords. Adult squamous characters such as hornification, spines and pearl formation are absent.

3. The exact origin of these tumors is as yet undetermined. It is believed, however, that they arise either from transitional epithelium or that they arise from squamous epithelium which in its growth loses its adult epithelial characters and assumes anaplastic features.

4. The most frequent seats of occurrence are the tonsil, base of tongue and nasopharynx.

5. Tumors composed of this type of cell form a small but definite proportion of intra-oral carcinomata. In the tonsil and the base of the tongue, the proportion of transitional cell to squamous cell carcinoma is approximately 1 to 10.

6. The clinical course of these tumors is characterized by the early and wide dissemination of the disease, so that the clinical picture is dominated by the metastatic process while the small deep seated primary

lesion, in many instances, remains undetected

7 A review of the cases shows many instances in which this disease has been erroneously regarded as bronchiogenetic carcinoma, endothelioma and lymphosarcoma. This is due to the fact that the deep location of the primary lesion and its early metastasis cause enlargement of the cervical nodes before the primary tumor ulcerates and produces symptoms. Attention is called to the importance of thoroughly excluding a deep seated primary transitional cell carcinoma before resorting to a diagnosis of primary disease of the lymph nodes.

8 The marked radiosensitivity of transitional cell carcinoma is one of its most characteristic properties. This property is so marked that the rapid response to radiation is a useful point in the differential diagnosis from the radio resistant squamous carcinoma.

9 The ability to completely eradicate the disease in the primary lesion and cervical nodes by radiation renders this the method of choice in the treatment of this lesion. An attempt to prevent distant metastases should be made by treating the lesion as early as possible by a method devoid of trauma in order to avoid disseminating this very cellular tumor process.

The writers wish to acknowledge their indebtedness to Dr. James Ewing, for his aid and suggestions throughout this study.

#### RLFLRLNCF8

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## CANCER OF THE PERIAMPULLARY REGION OF THE DUODENUM

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MANY writers on the subject of carcinoma of the ampulla of Vater have pointed out that the growth is ideally situated to make its presence known at an early stage. They have claimed that regional and distant metastases are late. Nevertheless the results of radical surgery have not been encouraging. In the reported cases, many patients presented a relatively long history of more or less indefinite complaints referable to the gastrointestinal tract before the onset of the icterus that finally led to operation. It must be somewhat a matter of good fortune for both surgeon and patient to find the growth well localized to the intraduodenal portion of the terminal bile duct. It is most often, although not exclusively in such situations that radical surgery has succeeded or at least allowed the patient to survive the operation and the immediate postoperative period. Within the past decade eight cases of periampullary carcinoma of the duodenum have been operated on at the Mount Sinai Hospital, in three of which radical operation was performed. It is the purpose of this paper to report these eight cases and at the same time to review the literature of previously reported cases.

According to Gray (14) the caruncula major of Santorini or the bile papilla is a projection in the lower part of a longitudinal fold of mucous membrane regularly situated in the second, or vertical portion of the duodenum, usually on the posterior wall at its junction with its left border. At the summit of the papilla, which may be covered by a small transverse fold of mucous membrane, the bile and pancreatic ducts empty. In about 50 per cent of the cases one inch above and one half inch or more in front of the bile papilla is a much smaller papilla, the caruncula minor of Santorini, on the summit of which the accessory pancreatic duct of Santorini opens when present. The ampulla of Vater is a conical cavity formed by the fusion of the

bile and pancreatic ducts and is much larger than the opening of the bile papilla. The average length of the orifice is 3.9 millimeters and the diameter 2.5 millimeters (Opie). The two ducts open by a common orifice, if there is an ampulla or by two separate orifices if there is none. In form the ampulla strongly resembles a clitoris, the apex being represented by a transverse fold or fissure and the frenulum by the longitudinal fold of the duodenum. The papilla and ampulla like other anatomical structures are subject to variations. Letulle and Nathan (20), following a series of careful dissections have described four types.

1. In the first type the projection just described and the ampulla are not present. The transverse fissure exists and in more or less complete fashion covers the choledochus opening. The choledochus receives the duct of Wirsung and pours the bile and pancreatic juices directly into the intestine.

2. The second type, which corresponds to the usual classical description given in most anatomies is more frequent than the one just described, but is not the most common. In the region of the papilla there is an elevation ending in the ampulla. The common bile and pancreatic ducts seemingly attached, open into this more or less rounded cavity, the depth rarely surpassing 4 to 6 millimeters, the diameter measuring 6 to 7 millimeters. Each of the canals seems to contract a few millimeters before it reaches the depth of the ampulla.

3. The third form is the form most frequently seen, being present in 8 of 21 cases. There is a small projection with a sort of depression but no real ampulla. The choledochus and duct of Wirsung do not come together to form a common ampulla but empty individually into the intestine being separated by a membranous partition about 1.5 millimeters in thickness.

4. In the fourth type there is a large papillary projection with the same disposition

of the two canals previously noted. These open by a punctiform or circular orifice about 1.5 millimeter in diameter, the orifices being divided by a vertical fringe. In other cases, the duct of Wirsung forms a concave gutter around the choledochus, the two canals appearing concentrically arranged.

These variations have more than an academic interest, for in cases of obstruction of the duct of Wirsung, the pancreatic juice may still be supplied and delivered into the intestine by the accessory duct of Santorini, or, occasionally the duct of Wirsung instead of terminating in the *caruncula major*, empties into the *caruncula minor*, so that an occlusion of the biliary papilla does not disturb the function of the pancreas in the least.

The histology of the ampulla of Vater is of importance because three different types of epithelium enter into its formation, that of the intestine, the choledochus, and the pancreatic duct. At the angle of the ampulla, intestinal epithelium is present with its large, clear, flat cells and mucous ones. The mucosa of the choledochus is formed by cylindrical cells, rather high, measuring from 25 to 30 microns. This mucous membrane is wrinkled, and between the plaques, are open secretory canals of ramifying glands resembling the biliary type, but secreting more than those in the superior part of the choledochus. The epithelial cells of the canal of Wirsung present a much lower type, almost cuboidal, from 12 to 15 microns in height. So in papillary carcinoma, tumor cells may arise from the duodenal mucous membrane in the region of the papilla, from the glands of Lieberkühn, from the glands of Brunner in the submucosa, from the mucosa of the choledochus, from the cells lining the pancreatic canal and, as Pic (22) and Pilliet (22) have shown, from the glands of aberrant pancreatic tissue which have been found buried in the depths of the ampulla. Much has been written upon the differentiation of ampullary, ductal, and duodenal malignancies from their histological appearance. Considered practically, the point of origin is only of academic interest because the clinical course and the surgical indications are the same in all groups.

While carcinoma of the choledochus is not common, it is four times as frequent as that arising from the pancreatic duct, making the latter and ampullary neoplasms rather rare.

If seen early, these tumors grossly present two varieties. They may be pedunculated growths, mobile in the ampulla, often covered with excrescences, occasionally eroded, varying in size from a small pea to a walnut or even larger, Angeli reporting a case in which the mass was the size of an orange. When they protrude from the ampulla of Vater, their origin is invariably from the common duct. The second group consists of the bloody, ulcerating, plaque type of tumors, which commonly arise from duodenal mucous membrane, occasionally so small as to be passed unseen in a hurried examination. The origin of the tumor is often very difficult to determine, even at autopsy, for a growth starting at the angle of the ampulla rapidly invades the duodenal wall, and since there is no sharp division between the mucous membrane of the duodenum and the choledochus, it is difficult to decide their intracholedochal or extracholedochal starting point. The differential diagnosis between choledochal tumors growing in the *pars pancreatica*, and primary pancreatic tumors, can usually be made because the former rarely invade the substance of the pancreas. Ampullary carcinomata regularly remain local and are late to metastasize, Perry and Shaw (27) noting metastasis in only 3 of 15 cases. In the four cases of periampullary carcinoma which were subjected to postmortem examination, from the surgical services of the Mount Sinai Hospital, New York, autopsy failed to reveal the presence of metastasis. Brewer (22) and Modowsky (20) believe that deaths occur before these tumors have a chance to metastasize, from the poisoning effects of the bile stasis and subsequent cholemic intestinal hemorrhages, for while these malignancies are small and circumscribed, they cause compression and actual blockade of two canals, draining two important glands, the liver and the pancreas. Following obstruction at the papilla, the bile passages and the gall bladder become markedly dilated and filled with aseptic, thick bile,

high in its percentage of mucus. Mucus occasionally replaces the biliary elements entirely to form "white bile" as reported in the cases of Koerber (22), Riedel (24), Arnberger (4), Kausch (15) and Lenormant (22) and Cohen. Stones are usually absent. The liver is enlarged, smooth and green, projecting usually below the free border of the ribs. The pancreas is normal in size unless its canals are completely obliterated in which case it is enlarged at first only to atrophy subsequently from a fibrous pancreatitis. Should infection complicate the disease, acute pancreatic necrosis may rapidly ensue. In 51 cases of periampullary carcinoma gathered by Geiser (12), 46 had obstruction of the common duct while only 12 were complicated by a simultaneous dilatation of the duct of Wirsung. In 4 of these the integrity of the pancreatic ducts had been disturbed. Letulle (19) reports an unique case in which the pancreatic duct alone was obstructed without interference with the choledochus.

If chronic irritation is a factor in the production of carcinoma, the biliary papilla or ampulla of Vater should be a site of predilection. The etiological factors involved are many. As the papilla projects into the lumen of the bowel it is subject not only to the irritation of the eddying alkaline currents from the ducts but also to the acid wash of the gastric contents. While stones appear to be directly related to malignancies of the gall bladder, the causal relationship of cholelithiasis to these choledochal neoplasms is not as definite. Schueller (33) in 1901 reported calculi present in 6 of 41 cases. Outerbridge (25) in 1913 in an analysis of 110 cases from the literature was able to find mention of stones in but 23, about 20 per cent. In Pallin's (26) series of 52 cases reported in 1920, cholelithiasis was present in 13, 1 in every 4. Cholelithiasis as a rule occurs once in ten autopsies. While the proportion of cases of carcinoma of the papilla complicated by calculi may appear high at first glance, it must be borne in mind that the majority of patients with papillary tumors are rather advanced in years and that the incidence of stones increases directly with age. Another very interesting and poignant fact is that

while gall stones occur in seven females to one male, carcinoma of the papilla occurred in twelve males to one female in Pallin's series. Onati (26) and Payr (22) go so far as to state that carcinoma may be a predisposing factor in the formation of gall stones by obstructing free biliary drainage. It is therefore exceedingly difficult to draw any definite conclusions as to the relation of cholelithiasis to these malignant tumors. Nor can these growths bear any relationship to ulcers of the duodenum for while the latter usually occur in the first portion, cancer is found in the second.

The symptoms which these neoplasms evoke are those of common duct obstruction with its associated sequelae. Jaundice is the dominant and outstanding feature. Its appearance is insidious, unheralded by pain and its intensity increases progressively. In Pallin's series it was present in all the 52 cases, varying in duration from 2 to 4 months before operative relief was sought, although cases have been reported in which the icterus was present for longer periods. In Morian's (38) case for one and three quarter years and in Mayo Robson's (25) case for 3 years. Koerte (38) believes that this form of icterus is constant in contradistinction to that caused by stone in which the jaundice is variable and with remissions. This is not universally true because a complete obstruction may be converted into an incomplete one by ulceration of the neoplasm as is evidenced by the cases of Durand (22), Devic (6), Lender (18), Koerber (22), Hartman (34), Morian and Hotz (38) and in one patient ulceration caused such a severe hemorrhage that death resulted. This type of intestinal bleeding however must be differentiated from the cholemic hemorrhages which are more common and just as serious, having been responsible for almost 50 per cent of the postoperative deaths. In the cases of Lannois ( ) and Courmont (22), Van Decos and Baville (22), Schieve and Letulle (22) the duct remained patent while the tumor tissue strangely infiltrated the choledochus wall.

Severe pain is not an outstanding feature although epigastric distress was present in over half of Outerbridge's (25) series. In the

rarer cases in which the pain was colicky, stones were often present.

If the pancreatic duct is involved, or if a chronic fibrosis of the pancreas complicates the picture, it may be evident clinically by occasional glycosuria or absence of the pancreatic ferments in the aspirated intestinal contents. The use of the duodenal tube in the diagnosis of surgical conditions in the ampullary region of the duodenum, while not of exceptional value, should be continually employed. The significance of the findings have already been emphasized by Crohn (10) and more recently Chiray, Benda and Milo clavitch (8) have reported a case in which a clinical history together with repeated aspirations of fresh blood from the duodenum, with absence of bile lead them to suspect a malignancy of the vaterian ampulla which autopsy verified.

Physical examination aside from the emaciation and cachexia and the intense icterus shows a diagnostic sign of major importance in the enlarged gall bladder. This observation was originally made and popularized by Courvoisier. Cotte (38), quoting Carnot states cancer in hepaticus, "petite vesicule", cancer at the confluence, "grosse vesicule hydropique", carcinoma in the choledochus "grosse vesicule plein de bil". The enlarged gall bladder, though present, may not be palpated because the overlying liver which too is often increased in size, obscures it. In 28 cases of carcinoma below the confluence, all except 3 gave evidence of an enlarged gall bladder, and in 2 of these, stones were present in a typical hydropic gall bladder. In cases of choledochal carcinoma, Courvoisier's law is regularly upheld unless the gall bladder has been previously shrunk by the contracture of scar tissue secondary to the inflammatory reactions caused by infection and cholelithiasis. Modowsky (26) is not in accord with this, for he found the size and the contents of the gall bladder quite variable in cases of choledochal carcinoma. It is likely, however, that a number of his cases were carcinoma of the confluence, with the cystic duct opening low in the choledochus.

The clinical diagnosis of carcinoma of the biliary papilla is rarely made because the

presence of an intense icterus automatically suggests either carcinoma of the head of the pancreas or impacted gall stone. Constant icterus, afebrile course, absence of pain and a large gall bladder point to neoplasm, remitting jaundice, fever, pain, and a non-palpable gall bladder favor impacted calculus. Icterus as a rule is constant, but in every fifth case it may vary. The constancy of a bilirubinemia may be checked by repeated estimations of bile in the blood serum by any of the methods in vogue, and while not absolutely reliable is more exact than clinical impressions as to variations in color. Temperature in two thirds of the cases is afebrile unless infection is present, when a typical intermittent fever may be present, not unlike the Charcot syndrome seen with stone. In a high grade constant icterus with an afebrile course, if the gall bladder is enlarged and there is reason to suspect malignancy, a diagnosis of carcinoma not only of the head of the pancreas, but also the papilla or the choledochus should be entertained. It is really the possibility that the new growth causing the obstruction might be periampullary which should induce surgeons to explore this type of abdominal malignancy provided the cholemic symptoms are not too far advanced. If the symptoms speak for a neoplasm and the gall bladder is not enlarged, carcinoma above the confluence of the cystic and common bile ducts must be considered. It must be differentiated from chronic pancreatitis and hypertrophic cirrhosis the latter condition strange ly simulating these malignancies.

In other words operation is indicated in all cases of obstructive jaundice, except those which are frank cases of carcinoma with metastasis, and an exploration should be performed early and not after months of purposeless medical treatment have so exhausted the patient as to render him beyond the pale of surgical intervention and redemption. For these individuals die, not from the surgical exploration or procedure, but from the toxic effects of a prolonged jaundice. Petren (26) is of the opinion that the severe danger of jaundice occurs when it has lasted from  $3\frac{1}{2}$  to 4 weeks, and that exploration should be done before 3 weeks have elapsed.

TABLE I—FIFTY-NINE CASES OF RADICAL OPERATION FOR CARCINOMA OF THE PERIAMPULLARY REGION OF THE DUODENUM

From 1898 to 1923

[illegible]

TABLE 1—Continued

Year	Surgeon	Operation performed	Result
1912	Oppenheimer (25)† (Fenderlin)	Choledochotomy at first then resection of entire choledochus and surrounding indurated area. Hepatic duct sutured to duodenum. Cholecystectomy. Stump of pancreatic duct which had been cut through sunk into duodenal wall.	Operative recovery. Died 1 year later from recurrence in liver.
1913	Hirschel (26)	Circular resection of the duodenum. End-to-end suture. Choledochoduodenostomy with tube. Resection of part of pancreas and pancreaticoduodenostomy and gastro-enterostomy.	Operative recovery. Died 1 year later from recurrence.
1913	Alglave (Pollet) (28)	Transduodenal excision. Choledochostomy.	Died 8 days after operation from cholera and anuria.
1913	Hartman (Stakevitch)	Transduodenal excision. Reimplantation of choledochus.	Operative recovery. Patient alive 18 months after operation.
1913	Clermont (26)	Transduodenal excision.	Died night of operation from hemorrhage.
1913	Klinschmidt	Cholecystectomy. Transduodenal excision.	Died eighth day from peritonitis.
1914	Doeg VanPaeve (26)‡	Transduodenal excision.	Operative recovery.
1914	Doeg VanPaeve (26)‡	Transduodenal excision.	Died fourth day postoperative from hemorrhage.
1914	Wiede (26)‡	Transduodenal excision.	Operative recovery.
1914	Wiede (26)‡	Transduodenal excision.	Died from cholemic hemorrhages. At postmortem no metastases found.
1916	Akerblom (26)‡	Transduodenal excision.	Died after 8 days from cholemic hemorrhages.
1917	Akerblom (26)‡	Transduodenal excision.	Died after 2 days from pancreatic hemorrhage.
1918	Anchutz (3)	Transduodenal excision and reimplantation of choledochus. Pylorus occluded and posterior gastro-enterostomy. Cholecystostomy for 8 days.	Operative recovery. Gained 30 pounds in 4 months.
1919	Lunblod (26)‡	Transduodenal excision.	Died after 3 days from cholemic hemorrhages.
1919	Olson (24)	Transduodenal excision and reimplantation of choledochus. Cholecystectomy with drainage.	Operative recovery. Patient alive 4 years later.
1919	Arnsperger (4)	Transduodenal excision and reimplantation of choledochus. Hepatic drainage.	Operative recovery. Patient died 6 months later from metastases.
1920	Brentano (6)	Transduodenal excision.	Operative recovery. Nine months later local recurrence.
1921	Propping (36)	Transduodenal excision and reimplantation of pancreatic and choledochus ducts.	Operative recovery. Patient alive 1 year later and gained 30 pounds in weight.
1921	Klinschmidt (17)	Transduodenal excision. Drainage of duct of Wirsung.	Operative recovery. Well 7 months later.
1922	Renshaw (32)	Choledochotomy. transduodenal excision (knife and cautery). cholecystoduodenostomy.	Died 9 days after operation.
1922	Bruett (7)	Cholecystectomy. Transduodenal excision and reimplantation of choledochus and duct of Wirsung.	Died 2 days after operation from peritonitis.
	Bruett (7)	Transduodenal excision and reimplantation of choledochus and duct of Wirsung.	Operative recovery. Patient alive 3 of a year later.
	Bruett (7)	Transduodenal excision and reimplantation of choledochus and pancreatic duct.	Operative recovery. Patient alive 6 months later.
1922	Tenani (36)	First operation. duodenotomy posterior gastro-enterostomy. division of choledochus with implantation of proximal end into efferent duodenal segment. Suture of duodenum and closure of abdomen without drainage. Second operation (one month later). duodenum mobilized and descending part resected. Diseased head of pancreas removed and pancreatic stump sutured into efferent duodenal segment and suture line protected with peritoneum.	Uneventful recovery. Postoperative reaction severe. Patient free from recurrence 3 years after operation.
1923	Dalla Valle (11)	Transduodenal excision with reimplantation of choledochus.	Died 3 days after operation.
1923	Pozzi (29)	Duodenotomy. Fixation of papilla with reimplantation of duct of Wirsung and choledochus. Cholecystgastrostomy.	Operative recovery.
	Pozzi (29)	Choledochotomy. Transduodenal excision of papilla with reimplantation of choledochus and Wirsung. Cholecystgastrostomy.	Died 6 days after operation from peritonitis.

† Reported by Outerbridge in 1913.

‡ Reported by Fallis in 1919.



TABLE I—Continued

No.	Sign	Operation performed	Result
193	Pot (9)	Daod n tomy Exc on of pap illa w th re implant n of h l doctus nd duct of W rso g	Operat rec very Pati t l 3 y rs ft ope to
2023	Beer (Case 1)	T a sd ude l exo n Ch l cystogastro my	Died n e hours from shock
94	Monchow t A V (Case 2)	Chol doctomy T ansd od nal e so Da ge to sut lines f c mm nd t a d d od n n	D d s d y ft rope at on fr m hrm rrbag
94	T mvs hew tch (37) (Abr moll)	Tran d od al ar ion	D ath r d y aft e oper t on f m d od n l f t l
94	Abell ( )	First pe ti Ch l cystostomy Se d ope ati n (a m ths lat ) ch l cystod ode os t my Thi d ope t o (j mo th lat r) d ode t my r d um appli cation aga n t g with	Ope t i e cov ery Ope t cov ry Ope t e cov ry P t at al ve 6 mo ths afte operat on
9	G hrbr ndt (3)	T d ot al c on w th r impl nt ion of om n b l nd p nc cati d ct	Ope t ve recovery P t nt al e 4 m ths l t r
95	M l l r (23)	T nsd oden l e c on	Ope t r cov ery P t t al v r ye r afte re ati
205	C be Ira (C se 3)	Ch l doctomy T a sd od n l e ci n Chol cy tost my and dr n ge	Ope at e eco ery D d r month l t fr m nt tates

The jaundiced patient has always been considered a poor risk. A glance at Table I will demonstrate the role of postoperative hemorrhage in the causation of death for these patients are especially liable to postoperative oozing and active hemorrhage. The blood of all patients with icterus should be tested for bleeding and clotting time before any operative procedure is undertaken. It may be advisable to supplement these two simple tests with a blood calcium time for if the latter is lower than the coagulation time calcium administered as medication is quite effective in lowering the coagulation period of the blood. Walters (39) has had excellent results from the intravenous use of 5 cubic centimeters of a 10 per cent solution of calcium chloride given daily for 3 days preceding operation. Inasmuch as the majority of these unfortunate patients are quite debilitated and dehydrated blood transfusions are especially indicated. Aside from their effect in diminishing bleeding they provide good nourishment and excellent stimulation to a devitalized system. Nor is it amiss to force feed these patients on a high caloric carbohydrate diet and if any difficulty is experienced in getting them to drink sufficient amounts of fluid a Murphy drip of 5 per cent glucose should be administered by rectum for Mann (39) has shown that a high carbohydrate reserve is an excellent protector against 'hepatic shock'.

which is apt to follow any operative procedure in the deeply jaundiced.

Local anæsthesia is to be preferred. If the temperament of the patient or the nature of the procedure contra indicate this nitrous oxide gas and oxygen should be chosen to secure adequate relaxation. From the work of Clairmont and Von Haberer (9) and Stahle (35) it is well known that cases of common duct obstruction often develop oliguria and may even develop a fatal anuria as in Algane's case (see Case 4). The exact mechanism of this untoward complication is still obscure except that it seems directly related to some element in the jaundice plus the added poisonous insult of a chloroform or ether anæsthesia. Pozzi (29) has employed spinal anæsthesia in 2 cases with excellent success.

The question of operative procedure depends upon the size location and relationship of the tumor to the surrounding anatomical structures. If the tumor lies deep in the choledochus or in the ampulla its relationship to the duodenum and the pancreas can be appreciated properly only after the duodenum has been duly mobilized or sufficiently incised. Most surgeons are loath to open the duodenum especially if marked jaundice exists but there is no other way in which the pathology can be adequately demonstrated. If the tumor is deemed inoperable a drainage oper-

ation of some character is indicated to relieve the unfortunate victim of the effects of bile retention and while the mortality of such procedures may appear high, some good palliative effects are often obtained. Cholecystostomy is undoubtedly the simplest procedure but not the least dangerous. The continual profuse, greenish drainage necessitates constant dressing, which is both distressing to the patient psychically and detrimental physically, because it robs the system of bile unless it is collected and fed by mouth through a stomach tube. Inasmuch as the gall bladder is invariably dilated it may be effectively employed to transfer the flow of bile by anastomosing it by suture or Murphy button to some part of the gastro intestinal tract. Payr (22) believes, and probably justly, that the duodenum is the most natural site for the neostomy, but it should be remembered that this will bring the biliary stoma quite close to the original tumor. Naturally, if a duodenotomy is performed for exploratory purposes, the opening should be used for the anastomosis (see Case 3). A cholecystogastrostomy is often effective, or, the jejunum can be utilized, and if combined with an entero enterostomy provides quite an effective method of drainage.

TABLE II—ANALYSIS OF SIXTY-FOUR CASES OF BILIARY OBSTRUCTION DUE TO CARCINOMA

	Cases	Mortality following operation—per cent
Location of carcinoma		
Head of pancreas	39	35
Common bile ducts	14	63
Ampulla	9	60
Duodenum	2	66
Type of operation		
Simple exploration	19	16
Cholecystostomy	10	70
Anastomosis	5	32
Cholecystectomy choledochostomy and duodenotomy	10	70

It is quite instructive to review the operative results obtained in 64 cases of jaundice due to obstruction from carcinoma, admitted to the surgical wards of the Mount Sinai Hospital from 1916 to 1925, in which, on exploration either a radical or a palliative drainage operation was performed (Table II).

Nineteen were simply explored and their wounds subsequently closed, 7 of these died, a mortality of 36 per cent. In 10, a cholecystostomy was made with a mortality of 70 per cent. Twenty-five were subjected to an anastomosis, the majority a cholecystogastrostomy, some a cholecystenterostomy, a few a cholecystoduodenostomy, 8 died, a mortality of 32 per cent. These figures, obtained from a small number of cases, should convince the skeptical that internal drainage operations are not attended with a risk so great as to make them prohibitive, and when once a coeliotomy is performed, the added risk of an anastomosis is practically negligible.

In those cases in which the gall bladder, because of previous disease, has become shrunk, and is unadaptable for anastomosis, or has been already removed, there is a theoretical possibility of uniting the suprapancreatic portion of the dilated choledochus to the side of the duodenum or the small intestine. Or, after division of the common bile duct and ligation of its distal end, to implant the proximal stump into the duodenum or anastomose it end to end or side-to-side. Kehr (16) was successful with a choledochoduodenostomy and Tenani performed a choledochenteroneostomy with success.

If upon opening the duodenum, the tumor is small and localized to the immediate region of the papilla, all that is necessary is its excision. This is obviously the simplest and easiest expedient. In this collected series of 59 cases, it was the procedure of choice in 53, in 50 through an anterior duodenotomy, in 3 through a retroduodenotomy. The general mortality was 44 per cent. In performing this so called papillectomy, there are several technical features worth considering.

The duodenum must be properly mobilized and then opened through a vertical anterior incision. If the tumor is small and pedunculated it may be ablated with a scalpel, the endothermy knife or the actual cautery. This was all that was done in the cases of Stein (25), Moschowitz, Beer, Cohen, Oppenheim (25), and others. If much of the duodenal wall has to be sacrificed in the cause of radicality,

the defect remaining should be carefully inspected for bleeding points, every effort being made for accurate hæmæstasis.

The integrity of the common bile and pancreatic ducts is often disturbed by the removal of the papilla. In this collected series it was necessary to reimplant into the duodenum the choledochus in 26 cases and the duct of Wirsung in 14.

The reinsertion of the choledochus into the duodenum will be attended with an inflammatory reaction in greater or lesser degree and it is questionable whether an immediate free drainage of bile through this oedematous neostomy can be obtained. In order to insure a proper hepatic decompression the question arises as to whether it might be advisable to combine papillectomy with a drainage operation. In this collected series 29 cases in which a simple papillectomy was performed through an anterior duodenotomy had an immediate mortality of 38 per cent. In 24 cases in which papillectomy was combined with an additional drainage operation either a choledochostomy, cholecystostomy, or cholecyst-enterostomy the mortality was 42 per cent. In spite of this slight increase in mortality it would seem more logical to employ a drainage operation when practical and especially in those cases in which the choledochus or pancreaticus has to be reimplanted. Because tension is certainly taken off the new suture line bile flow is assured and should stricture or local recurrence occur as happened in the cases of Mayo (38) and Rixford (25) a secondary operation will not be necessary.

The opening in the anterior wall of the duodenum should be carefully closed with three layers of sutures and it might be advisable to insure against the possibility of a duodenal fistula as happened in the case of Tomaschewitch (37) and Vertroogen (38) and Case 4 in our series to perform a posterior button gastro-enterostomy and pyloric exclusion by the Berg (5) method. A prophylactic gastro-enterostomy was done by Cordua (38), Cuneo (38), Hotz (38), Anschütz (3) and Tenani (36) with good results.

Occasionally even though the surgeon may feel that he has removed all tumor tissue macroscopically microscopic areas may be

left behind as happened in Case 2. It might, therefore be advisable to implant radium seeds of either the platinum or gold variety, into the duodenal wall. Of course the dangers of secondary perforation and hæmorrhage must be carefully considered. Upcott (38) in 1911 was the first to employ radium for after a papillectomy some involved glands in the gastrohepatic omentum were left behind and 11 days after operation 5 milligrams of radium enclosed in a silver sheath attached to a probe were inserted into a cholecystostomy opening deep into the cystic duct. This was left in place for 6 hours and the next day the treatment was repeated for 4 hours. One month later the sinus healed there was no further recurrence of the jaundice and the patient gained weight. More recently Abell (1) upon reexploring a patient after a cholecystostomy found an enlarged papilla a specimen of which upon examination showed an adenocarcinoma. A button cholecystoduodenostomy was then performed. Three months later an exploratory celiotomy was undertaken and no evidence of metastasis was found. A duodenotomy revealed the papilla increased in size from five eighths to three quarters of an inch and 25 milligrams of radium in two tubes were anchored against the growth with plain catgut and the tubes tied with heavy silk through the mouth. The radium was removed at the end of 12 hours. The patient was well 6 months later and weighed 150 pounds.

That simple papillectomy in selected cases may be sufficiently helpful is attested by patients who have survived 1 year or more the longest case being the one recently reported by Lewis (21) in which a patient operated upon by Kelly was alive 9 years after operation. Olanis (24) case survived 4 years. Koerte's (38) patient was alive 3½ years. Pozzi's (29) 3 years. Hartman's (34) 1½ years. Propping's (30) 1 year and Muller's (23) 1 year. To be sure these are not many but they give some encouragement and stimulation for further surgical endeavor in this direction.

In other cases because of the further extension of the tumor papillectomy may not be sufficiently radical and to get beyond the

growth, a circular resection of the duodenum combined with a partial pancreatectomy may be necessary. This is a big operation requiring time and is rarely indicated, because the debilitated condition of these patients will tolerate in only exceptional instances a procedure so often associated with shock such as this. The rarity of cases surviving this operation are silent witnesses to its magnitude. After careful search of the literature, the celebrated cases of Halsted (38), Kausch (15), Hirschel (26), and Tenani (36) were the only ones found surviving the procedure. It would seem more practical to perform this operation in two stages: the first should be a drainage operation, primarily a means to rid the patient of his icterus, and thus better his condition for the more radical second part.

Halsted, who performed the first radical operation in 1898, resected a portion of the duodenum, restoring its continuity with an end to end suture anastomosis and reimplanted the choledochus and pancreatic ducts, at the same time doing a cholecystostomy. Three months later, a cholecystoduodenostomy was made. The patient died seven months following the primary resection, from recurrence. Kausch, in his case, did a preliminary cholecystojejunostomy and 2 months later performed a resection of the duodenum and part of the pancreas, doing a pancreaticoduodenostomy and gastroenterostomy. Although the patient made an operative recovery, death occurred 9 months later from cholangitis.

Tenani, more recently, at his first operation did an exploratory duodenotomy followed by a posterior gastroenterostomy and after dividing the choledochus, implanted the proximal end into the efferent duodenal segment. He then sutured the duodenum and closed the abdomen without drainage. The patient made an uneventful recovery. At the second operation 1 month later, he mobilized the duodenum and resected the second part together with a diseased part of the head of the pancreas. The pancreatic stump was sutured to the efferent duodenal segment, the suture line being adequately protected by peritoneum. The patient was alive and free from recurrence 3 years after operation.

Hirschel performed his operation in one stage but few surgeons could complete this extensive procedure in his remarkable time of 1 hour. The procedure consisted of a circular resection of the duodenum with end to end suture, a choledochoduodenostomy with a tube, a resection of part of the pancreas with a pancreaticoduodenostomy and a gastroenterostomy.

If the carcinoma arises definitely from the mucous membrane of the choledochus, radical extirpation is limited to those cases in which the tumor is situated just above the papilla. This can be appreciated only after the duodenum has been mobilized. A retroduodenal papillectomy was performed by Mayo (38), Hotz (38) and Slavner (26). Oppenheimer (25) resected the entire choledochus together with the papilla and reinserted the hepatic duct and pancreatic duct into the duodenal wall. The patient died 1 year later from recurrence. If the tumor occupies the pars pancreatica, excision is practically impossible.

When the mortality of either palliative or radical procedure in peripapillary carcinoma is considered, it would seem advisable to abandon all surgical endeavor, but on second thought, one is inclined to agree with Kocher (7) who said "Some of these miserable individuals are relieved by palliative measures, some relieved for longer periods of time following the more radical procedures and sometimes the worst which happens to them is not inconsistent with the obliteration of human suffering."

#### FIGHT CASES OF CARCINOMA OF THE AMPULLARY REGION OF THE DUODENUM FROM THE SURGICAL SERVICES OF THE MT SINAI HOSPITAL 1915-1925

##### *Three Cases of Carcinoma of the Papilla*

##### *in Which Radical Operation Was Performed*

CASE 1 A C No 47, male, age 34 years was admitted to the hospital March 22, 1923. The family history and past history are irrelevant. The patient said that he had had jaundice for 6 months and during that period had lost 20 pounds. He had noticed that his urine was dark and his stools light, and then he complained of a pain in the right hypochondrium. Physical examination revealed a pronounced icterus and the gall bladder and liver were definitely palpable. A diagnosis of carcinoma of head of the pancreas was made.

The operation was done under local anesthesia supplemented by gas and some ether. The gall bladder was found to be distended with bile but there were no calculi and after the gall bladder had been emptied a small hard movable tumor could be felt in the papillary region of the duodenum. The duodenum was mobilized and a transverse duodenotomy performed; the tumor was excised in two pieces without any bleeding. It was a hard tumor covered with a mucous membrane and about the size of a small cherry. Following the excision there was a profuse flow of bile from the duct. No further obstruction could be felt with the probe. The duodenum was then sutured in three layers and reinforced with a peritoneal free fat flap. A rubber dam drain was placed into Morrison's pouch and a suture cholecystostomy was done. The abdomen was closed in layers. After the operation the patient showed signs of shock and possibly hemorrhage and died within 10 hours. The pathological examination of the removed tumor revealed an adenocarcinoma of the papilla.

CASE S. H. No. 603, a female age 54 years entered the hospital January 9, 1924 and died January 18, 1924. She gave a history of a painless intermittent jaundice which recently had apparently increased. She had noticed that there was bile in her stools. On examination she looked very emaciated and deeply jaundiced; her gall bladder could be easily palpated below the free border of the ribs.

The abdomen was entered through a right rectus muscle splitting incision. The gall bladder was found to be markedly distended while the common bile duct was about 2 inches in diameter. No calculi were found in the common duct but a few could be felt through the thin wall of the chronically inflamed gall bladder. A choledochotomy was performed and a mobile mass could then be felt at the ampulla. After a transverse duodenotomy this mass was revealed to be a hard tumor of the ampulla. The tumor was excised and the duodenum and common duct were closed. Drainage was placed to the suture lines and the abdomen closed in layers. The patient died from hemorrhage 5 days after the operation.

Autopsy. The body is that of a white female about 50 years of age. The skin is markedly jaundiced. The conjunctivæ are icteric. There is a linear high right rectus incision about 8 centimeters in length through which numerous rubber dams, gauze and tube drains project and around this the wound area is hemorrhagic and inflamed. Leading down from the abdominal surface the drains go to the duodenum. A gauze packing and a large rubber dam drain about 1 centimeter in diameter, filled with blood clot goes down to the cystic duct. Around the cystic duct and the second and third parts of the duodenum the parts are covered with a large amount of blood clot. This blood is localized to the operative field.

The lungs are voluminous and weigh 1140 grams. The pleuræ are smooth and glistening except in the region of the left upper lobe where there are numer-

ous fibrous and fibrinous adhesions. On section the lungs are markedly oedematous and exude large amounts of a hemorrhagic oedematous fluid. The trachea and bronchi are filled with a frothy oedematous fluid. The pulmonary vessels and the anterior mediastinum are negative. The posterior mediastinum contains a number of large soft lymph nodes.

The heart weighs 400 grams. The pericardium is negative. There is a moderate amount of epicardial fat. The heart musculature is brown in color and somewhat flabby and shows cloudy swelling. All the valves are negative. The chambers of the heart are filled with dark viscid blood clots. The aorta contains a number of atherosclerotic patches some showing early calcification especially in the first part of the arch. The intima is markedly bile stained. The coronary arteries are negative but there is a small accessory right coronary orifice present.

The œsophagus is negative. The stomach is large and distended; its wall is extremely thin and contains about a liter of dark bloody fluid. The duodenum and the small intestines also contain a large amount of blood clot. The cæcum and ascending colon are markedly distended with gas and contain enormous amounts of fluid and clotted blood. The remainder of the colon and the rectum contain blood and tarry fecal matter.

The liver is enlarged weighing 2020 grams. Its surface is smooth, dark green in color and it is extremely firm in consistency. On section the parenchyma was found firm and markedly bile stained. The bile ducts are dilated. The gall bladder is also dilated and contains four faceted smooth surfaced bilirubin calcium stones. The cystic duct is also dilated throughout its course. The hepatic and common ducts are markedly dilated; the common duct measuring about 2 centimeters in diameter throughout its course. There is a suture line which extends for a distance of about 3 centimeters along the common duct and then down across the second and third parts of the anterior surface of the duodenum for a distance of 3 centimeters. This suture line the remains of a choledochotomy and a duodenotomy is competent and there is no leakage. On the inner surface of the duodenum the papilla of Vater has been removed and the common duct enters the duodenum with its orifice about 1 centimeter in diameter. There is a large area of denuded mucous membrane in the duodenum which extends proximally in this structure for a distance of about 3 centimeters. This ulcerated area which is surrounded by small fragments of inflammatory and tumor tissue is the site of removal of a carcinoma of the papilla of Vater which extended to the duodenal mucous membrane. The denuded area is about 3 centimeters in length and 1.5 centimeters in width. There are still present numerous bits of tumor tissue and at the proximal end of this wound there is a small papillary nodule, firm in consistency, neoplastic in appearance. The base of this area and the surrounding tissue is markedly hemorrhagic and

inflamed At the orifice of the common duct on the duodenal surface, there is a catgut hæmostatic suture which is loose and lies open in the duodenal lumen On section, the neoplastic area extends through the coats of duodenum and seems to involve the anterior surface of the head of the pancreas

The pancreas is small, firm, fatty, fibrous in consistency and shows no gross pathological change except for a slight involvement as described above

The spleen is small, weighing 100 grams Its capsule is gray in color, wrinkled, and shrunken On section, the organ is pale pink in color, shows marked shrinkage, and is fibrous

The adrenals are negative, grossly

The kidneys together weigh 300 grams Beneath the capsules which strip easily, the kidney shows a slightly granular surface They are injected On section the markings are distinct, pale in color and show a few petechial hæmorrhages in the pelvis The ureters and bladder are negative The uterus and tubes are negative The cervix is small Ovaries are small and fibrous

*Microscopic examination* The liver shows bile stasis There is an increase in fibrous tissue and periportal spaces There is an adenocarcinoma arising from the papilla of Vater There is a postmortem change in the pancreas which shows areas of abscess formation There are bile pigment casts in the tubules of the kidney There is postmortem change in the adrenals

*Diagnosis* (Operation choledochotomy and duodenotomy for cholelithiasis and carcinoma of papilla of Vater) postoperative hæmorrhage into intestines cholelithiasis

*Cause of death* Postoperative hæmorrhage

CASE 3 A M, No 258996, female, age 44 years entered the hospital September 18 1925 and left the hospital 5 weeks later The only facts of importance in her past history were an appendectomy and oophorectomy done 20 years previously The onset of her present illness dates back 4 years when attacks of chills started unaccompanied by fever, but associated with vomiting These attacks occurred quite frequently from then on For the past 5 weeks there was a progressive jaundice together with acholic stools, loss of 20 pounds in weight and a general weakness On swallowing, patient experienced a sense of oppression in the epigastrium

Physical examination showed an emaciated, icteric woman, weighing 107 pounds with scratch marks on the skin and several areas of ecchymosis There was a midline hypogastric scar in the abdomen and some fullness in the right upper quadrant where a smooth cystic mass was felt The free edge of the liver and the lower pole of the right kidney were palpable

The blood picture and blood chemistry were normal The Wiskemann was negative The bleeding time was  $8\frac{1}{4}$  minutes and the coagulation time 9 minutes The Van den Bergh test was positive by the direct method the indirect was 1-50 000 The urine contained bile and a faint trace of albumin The stools were clay colored, containing neither bile

nor urobilin Operation was done September 18, 1925, under nitrous oxide and oxygen anaesthesia The gall bladder was distended with white bile which was emptied by aspiration No calculi were found in the gall bladder or ducts, the pancreas was normal The common duct was opened and probed and in the duodenum a mass was felt The duodenum was opened through an incision in the anterior wall, and a tumor the size of a cherry was located at the site of the ampulla of Vater The entire tumor was readily delivered outside the lumen of the gut, the mucous membrane about it was circumscribed and the intramural portion of the common and pancreatic ducts was exposed by traction and thus cut across The mucous membrane of the duodenum was then sutured with fine chromic gut to the cut edge of the ducts, after this a probe could be readily passed from the duodenum up into the common duct The duodenum was closed in four layers the common duct was sutured and the gall bladder was drained

*Postoperative course* The first 8 days were uneventful, the wound healed by primary union On the ninth day a hæmatoma developed in the wound and the following day a large amount of blood was noted in the stool A 500 cubic centimeter citrate transfusion was given The bleeding time before the transfusion was  $11\frac{3}{4}$  minutes the coagulation time 10½ minutes, after the transfusion these were 5 minutes and  $4\frac{1}{4}$  respectively Further convalescence was uninterrupted One month after the operation a normal concentration of pancreatic ferments and clear bile were obtained by the duodenal bucket The patient's weight increased and she left the hospital 5 weeks after the operation

*Subsequent course* For 5 months the patient remained symptom free Then in March, 1926, she began to have severe pain over the upper end of the sternum In May she was admitted to the Montefiore Hospital, at which time she had bone metastases in the sternum, skull, lumbar spine, ilium, and left humerus Up to the time of her death, August 2, 1926 she showed no sign or symptom of local recurrence or abdominal metastases No postmortem examination was permitted

### *Five Cases of Carcinoma of the Papilla in Which Palliative Operation Was Performed*

CASE 4 E H, a female, age 32 years, was admitted to the hospital December 8, 1919, and died December 28, 1919 The patient complained of attacks of severe pains in the right upper quadrant accompanied by fever and chills These attacks started 4 months ago Two months ago she became jaundiced She had no clay colored stools, but she has lost 20 pounds in weight Physical examination shows an emaciated, acutely ill woman, with tenderness in the right upper quadrant where an indefinite mass is felt

Operation was done December 9, 1919 Pericholecystic adhesions were found The common duct is enormously dilated There is a tumor mass

involving the duodenum and the head of the pancreas. In the duodenum there is a small ulcer. The head of the pancreas is freely movable and there is no glandular involvement. Procedure: cholecystectomy, choledochostomy, duodenotomy.

On December 14, 1919, anuria developed with collapse. On December 25, 1919, a duodenal fistula was found and in spite of stimulation the patient died 3 days later.

**Autopsy.** Body is that of a female age 3 years, rather poorly nourished and anæmic. Moderate rigor mortis is present. The skin shows no discoloration anywhere. There is a postoperative scar about 4 inches long over the right rectus muscle. At the upper end of this scar there is an opening about 1 inch long. Below this the wound is healed. The opening communicates with the peritoneal cavity and there is a fairly walled off sinus admitting two fingers and extending anteriorly and above the liver.

The lungs lie free. The right lower lobe is atelectatic. On section this part cuts firmly and does not seem crepitant. Remainder of the lung appears normal.

The pericardium is normal. The valves and endocardium appear normal. The walls are not thickened. The myocardium appears rather pale. The aorta near the aortic valve shows a few atheromatous patches.

There are adhesions of intestines about the sinus previously described. On opening the abdomen the remainder of the peritoneum appears quite normal. There is no free fluid present.

The stomach and intestines appear normal. About 1 1/2 inches below the pyloric sphincter there is seen a thickened area of mucosa about the size of a half dollar apparently surrounding the papilla of Vater. In the ampulla itself is seen a small polypoid mass the size of a split pea and of similar appearance to the thickened mucosa of the duodenum. The duodenum itself appears dilated. On the anterior wall of the duodenum is an opening about 3/4 of an inch long (due to duodenotomy) which communicates with the abscess cavity. The remainder of the intestines are collapsed.

The gall bladder has apparently been removed. There is an opening about 1/2 inch long near the upper part of the common bile duct. Below this the common bile duct is dilated to the thickness of the index finger.

The liver is apparently not enlarged. On section the lobules appear quite distinct and the liver has the appearance of a chronically congested organ. The liver is not icteric.

The pancreas is apparently normal throughout. The head of the pancreas does not seem to contain any neoplasm. An accessory pancreas the size of a half dollar is present in the anterior wall of the duodenum. The spleen is apparently normal.

The kidneys are moderately enlarged. The capsule strips easily on section the cortex appears extremely pale and the striations are poorly marked. The medulla has a somewhat purplish color.

The adrenals are apparently normal.

**Diagnosis.** Adenocarcinoma of ampulla of Vater and duodenum. Accessory pancreas. Obstructive jaundice. Duodenotomy.

**Microscopic examination.** The mucosa and part of the muscularis of the duodenum is involved by an adenocarcinoma which in places presents a colloid appearance. The greater part of the wall of the duodenum is replaced by an adenocarcinoma only in a few places strands of the muscularis are involved. The accessory pancreas itself does not appear to have given rise to the neoplasm but rather appears to have been invaded by the carcinoma. The islands of Langerhans are exceedingly small. This part of the organ does not appear to contain any carcinoma. In the tail of the pancreas no carcinoma is present. The liver shows moderate passive congestion. The centers of the lobules and the cells about the hepatic veins contain brown pigment. This is also present in the Kupffer cells in these regions.

**CASE 5. A. K.** a female age 47 years was admitted to the hospital January 20, 1922, and died February 3, 1922. The patient complained of progressively increasing jaundice during the past 2 months. She had lost 20 pounds in weight, her stools were clay colored, her urine dark, but there was no pain. There was marked anorexia. Physical examination shows a markedly jaundiced emaciated woman whose liver and gall bladder are distinctly palpable.

**Operation.** The abdomen was opened through a right rectus incision. The gall bladder and common duct were found to be greatly dilated. A cholecystostomy was done with liberation of much clear fluid then a choledochotomy. A probe can be passed into the duodenum without any difficulty. The pancreas is enlarged but not hard. A tube is placed in the region of the choledochostomy. Clove wire of the abdomen was done in layers. The patient died 6 hours later from shock.

**Autopsy.** The body is that of a middle aged woman and shows incomplete rigor mortis, no petechiae. The skin and mucous membranes are intensely icteric. The esophagus is negative. The trachea contains a small amount of frothy, pinkish fluid. The pleural cavity is free from fluid and adhesions. The lungs are well aerated. There is moderate congestion at the bases. The pericardial cavity contains a normal amount of pericardial fluid. The heart is flabby. The musculature is light brown in color. The valves are negative. The coronaries show a moderate amount of atherosclerosis. The aorta shows a small amount of subintimal fatty infiltration. The elasticity is good. There is an 8 inch incision in the midepigastrium the lower two thirds of which is sutured. The upper angle contains rubber tube drains one of which is inserted into the common duct and the other into the gall bladder. The one into the gall bladder contains a blood clot. The other into the common duct contains thick black bile. When the peritoneal cavity was opened

A very large amount of blood clot was found over the entire right lumbar gutter, covering the anterior surface of the right lobe of the liver. The surface of the liver is smooth. A cut section shows a greenish surface. The biliary passages appear to be dilated. The hepatic and portal veins are negative. The gall bladder is found markedly distended with blood clot. There are no stones present. The cystic duct was investigated and found patent and dilated. The hepatic duct is patent and somewhat dilated. The interhepatic portions of the hepatic duct are found to be somewhat dilated and filled with a thick black bile. The common duct is drained by a large rubber tube. It is considerably dilated. The papilla of Vater appears prominent and has the shape of a nipple. It is oedematous. A probe can be passed through the opening, only by force. There is a small mass of tissue (1 millimeter) about the mouth which feels harder than the surrounding tissue and on cut section has a whitish appearance. There is an enlarged, hard lymph node along the course of the cystic duct. The head of the pancreas feels very hard and on cut section has a deep yellowish color. It cuts with a great deal of resistance but appears to be fibrosed pancreatic tissue. The lobulations are preserved. There are other such areas throughout the pancreas but they do not appear to be new growths. The spleen weighs 120 grams. The capsule is dense. On cut section, it shows increase in fibrous tissue. The kidneys together weigh 300 grams. Capsule strips with ease revealing a few small cysts. Cut section shows marked icteric tinge of the entire surface. The adrenals appear to be negative. The stomach contains a small amount of thick light yellowish fluid. There are no lesions present in the mucosa. The intestinal tract reveals no blood.

**Microscopic examination.** The papilla of Vater shows carcinoma which in the deeper portion is spheroidal in type. There is one area of a typical squamous cell carcinoma. Transitions from squamous to spheroidal type are to be seen. The lymph node along the cystic duct shows squamous cell carcinoma. There is a moderate amount of hypertrophy of the heart muscle. The pancreas shows small amount of intra acinar fibrosis. The liver is somewhat fatty. Glisson's capsule is infiltrated by numerous large cells. The biliary capillaries are moderately distended. The periportal tissue is increased in amount. The biliary ducts appear to be moderately dilated. The spleen is congested. The vessels show marked thickening. The Malpighian corpuscles are diminished in size. There is a distinct increase in reticular tissue. The mucosa of the gall bladder is atrophic. The submucosa muscularis and serosa are infiltrated by numerous large round cells. The larger vessels along the serosa contain organized thrombi. Haemorrhage has taken place into the deeper layers of the muscularis.

**Diagnosis.** Squamous cell carcinoma of the papilla of Vater (Cholecystotomy and cholangiotomy for hydrops of the gall bladder and common duct obstruction).

**Cause of death.** Postoperative haemorrhage into the peritoneal cavity.

CASE 6 No 60 6, a male, age 50 years, complains of burning and discomfort in the epigastrium together with loss of 5 pounds in weight in past 3 months. During past 3 weeks he has been jaundiced. Physical examination discloses a markedly jaundiced man, whose liver is palpable at the umbilicus.

Operation was done under nitrous oxide gas and oxygen anaesthesia. The liver was enlarged to the umbilicus. The gall bladder was increased in size but there were no stones. The common duct in the region of the papilla felt nodular. The stomach was negative on examination. The operative procedure consisted in a button anastomosis between the gall bladder and the first portion of the duodenum. The abdominal wall was closed in layers. Patient's recovery was uneventful. Jaundice had practically disappeared at the time of discharge 2 weeks after operation.

CASE 8 No 41A 9, a female, age 48 years admitted to the hospital February 9 1923 and discharged March 3 1923. The patient complained of pains in the right upper quadrant radiating to the shoulder. There had been four attacks of this in the past year, each attack lasting for 2 hours and the last one occurring 5 weeks before admission was followed by jaundice, clay colored stools, and dark urine. She had lost 40 pounds in weight. Physical examination showed a jaundiced middle aged woman, slightly emaciated, with a globular movable mass in the right upper quadrant. The liver could be felt four fingers below the costal margin.

The abdomen was opened by right pararectus incision. The liver was enlarged, hard and smooth. The gall bladder was markedly distended in the papillary region was a hard mass which felt like a new growth. In the region of the foramen of Winslow were a few small, hard masses and enlarged glands about the common duct. A suture cholecystgastrostomy was performed. The postoperative course was uneventful, and the patient was discharged improved.

CASE 8 A S, No 160934, a male, age 58 years, was admitted to the hospital August 14, 1916, and transferred to surgical service on August 24, 1916. He gave a history of painless but progressive jaundice, which had started 4 weeks before his admission, with pruritus, acholic stools, and a loss of 25 pounds in weight. On examination he was found to be poorly nourished and jaundiced, the liver was found palpable 3 finger breadths below the costal margin and there was a fullness in the epigastrium.

An operation was done under nitrous oxide gas and ether anaesthesia. The abdomen was entered through a 5 inch right rectus splitting upper incision. The gall bladder was found to be dilated and the common duct tremendously so. Near the head of the pancreas a small mass could be felt, one portion of this was exceedingly hard and suggested the feel of a stone on needling. The duodenum was exposed and opened, a small carcinoma of the papilla of



Water was found and a part excised for pathological examination. A probe could be easily passed into the common duct. As a purely palliative procedure a button cholecystoduodenostomy was performed. The gall bladder which was opened was found to contain a very thin colorless mucoid material. Through a rent in the omentum the posterior wall of a very small stomach was anastomosed by Murphy button to the nearest jejunal loop and the rent sutured to margin. The pylorus was excluded with Pagenstecher exclusion stitch. Two rubber dam drains were left in the upper angle and one packing in the region of the cholecystoduodenostomy. The abdomen was closed with heavy through and through silk sutures. An intravenous infusion of saline (16 ounces) was given immediately. At the close of the operation the patient's condition was fair. The patient died 4 days after the operation. Pathological report of specimen: adenocarcinoma.

**Autopsy.** There is very intense icterus of the skin and all structures. The peritoneal cavity contains no free fluid. There is a Murphy button cholecystoduodenostomy in good condition and a posterior no loop Murphy button gastroenterostomy also in good condition. The omentum is thickened and inflamed and adherent to the structures about the gall bladder and duodenum. The stomach is distended and at the pylorus there is a linen thread occlusion ligature which completely closes the lumen. The duodenum was opened along the anterior wall at the site of the papilla of Vater is a soft cauliflower like mass 3 by 4 centimeters in size which projects 2 centimeters. The bile ducts are very much distended and thickened and contain a heavy brownish bile stained material. A probe was passed down the common duct in to the duodenum through the ducts above described. The pancreas is normal in size. On gross examination however the pancreatic duct is found to be markedly dilated. A probe passed down into it also passed the duodenum through the center of the tumor.

The liver is somewhat smaller than is normally found. It is dark green in color and markedly icteric. Bile ducts contain thick brownish bile stained material. The transverse colon proximal to the region opposite the opening in the transverse mesocolon where the gastroenterostomy is situated is very dark red in color and has the appearance of a beginning gangrene. All of the intestine including the small intestines above this area are tremendously distended beyond this area they are collapsed. A careful investigation of the vessels

in the transverse mesocolon revealed no thrombi in any of them.

Diagnosis: carcinoma of papilla of Vater.

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# CLINICAL SURGERY

## FROM THE UNIVERSITY OF CALIFORNIA HOSPITAL NEPHRECTOMY

By FRANK HINMAN, M.D., F.A.C.S. SAN FRANCISCO

THERE is a certain charm about surgery of the kidney. It exercises the imagination, uses the intellect, requires judgment, and benefits by skill and experience sufficiently to make it fascinating. Interest is diversified. Problems that often require a high degree of intelligent solution arise throughout the course of almost every case. The problem of diagnosis comes first with its highly technical methods of examination, in the use and proper interpretation of which both training and experience are required. Then arises the problem of preparation for surgery, such as catheter drainage or nephrostomy, and the problem of delay against early operation. Finally, the problem of choosing the best surgical attack is a very interesting and vital one. There are commonly two kidneys. Disease may be unilateral or bilateral but, if unilateral, the healthy side may become affected later, so that conservation of renal tissue is in order so long as it promotes the general interest of the patient. Nephrectomy is radical but is often the only surgery that serves the patient best. The surgeon chooses for the patient the conservative or radical way, and the result in time proves the correctness or error of his judgment. The satisfaction of exact diagnosis and curative treatment is no greater in any other field of surgery.

The possession of two kidneys and predominance of unilateral disease makes nephrectomy the commonest operation on the kidney. Radical removal is required in tumor and tuberculosis of whatever stage. But nephrectomy for stone, for hydronephrosis, for solitary cyst, for pain or infection, means that the lesion is hopelessly advanced. Early diagnosis and treatment will diminish the frequency of nephrectomy in these cases.

The first reported nephrectomy in America was by Wolcott in 1861, in Europe, by Gustav Simon, in 1869. Simon killed his second patient by digital exploration during convalescence. The fatality following the fourth nephrectomy case reported

by von Bruns in 1878 delayed surgery of the kidney another decade or until antiseptics was firmly established. Even then the mortality was high until with more accurate diagnosis, better preparation for operation, improvement in judgment of selection of cases and in surgical technique and methods, nephrectomy has come to be one of the safest of major operations (1 to 10 per cent, varying with the disease and the operator).

The conditions for which nephrectomy is most frequently indicated are renal tuberculosis, renal tumors, and calculous pyonephrosis. The risk will vary with the condition of the patient. Age has very little influence, other things being good, but complications of the cardiovascular system, of the lungs, etc., must be as carefully considered as in all major surgery.

First consideration belongs to the opposite kidney. Removal of a solitary kidney should never occur and removal of a diseased hypertrophic kidney, when its mate is infantile, causes the death of the patient in most instances. Removal of one kidney, when the opposite one is also diseased, calls for a high degree of judgment. In such bilateral conditions treatment of the less injured side by catheter drainage, nephrostomy, removal of stones, plastic operations, ureteral transplantation, should, in most instances, precede nephrectomy. In renal tuberculosis the mortality will be lowest in early lesions confined to one side, highest in cases with bilateral disease or generalized pulmonary and genital tract involvement. Of 847 cases reported between 1902 and 1908 by various European surgeons, there was an operative mortality of 11.1 per cent. In 190 nephrectomies for unilateral renal tuberculosis, Persson\* (Stockholm) in 1925 reports an operative mortality of 7.3 per cent, O'Neil<sup>3</sup> (Boston) of 3.8 per cent in 103 cases. Of our own 70 cases, there are

\* Brodeur reports that up to 1890 the mortality of nephrectomy was 58 per cent.

<sup>1</sup> Persson. Ann. Surg. 1925 122:111-126. 51.

<sup>2</sup> O'Neil. Calcutta Med. and Surg. J. 1924 p. 572. Philadelphia Lea & Febiger.

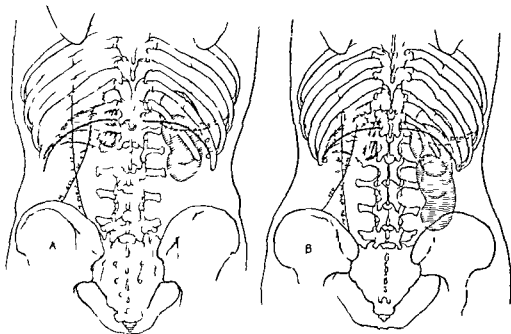


FIG. 1. The position of the kidneys. *A* In the male adult. *B* In the female adult. The heavy curved line on both sides (diaphragm) shows the usual limits of attachment of the diaphragm. The dotted line on the right only (pleura) shows the usual extent of reflection of the pleura. On the left side a short twelfth rib is shown. The vertical lines on the left that cross indicate the outer borders of the sacrospinalis and quadratus lumborum. The costovertebral ligament beneath these muscles is divided in the oblique lumbar incision when better exposure of the kidney is required. The usual variations in the kidney position are shown. (After Broedel.)

two deaths in 60 unilateral, a mortality of 1.6 per cent, in 10 bilateral, or 50 per cent. 2 deaths (one autopsy) were due to embolism, a cause of death in nephrectomy for tuberculosis never before re-

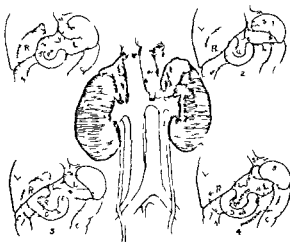


FIG. 2. The usual variations in the intra-abdominal relations of the kidneys. The adrenals have a separate capsule unattached to that of the kidneys and rarely interfere with delivery.

ported according to O'Neil. In tumor of the kidney the operative mortality is high. The risk is greatest with advanced and large tumors, smallest with early localized growths. In 24 cases of Squier<sup>1</sup> it was 50 per cent; in 62 cases of Braasch<sup>2</sup> excluding 2 explorations, 11 per cent; in 268 cases of Paschen<sup>3</sup> 19 per cent. Personally we have had one death (child) in 1 case. In pyonephrosis the virulence of the infection and general resistance of the patient influence the result even with a perfectly healthy kidney on the opposite side. In 40 cases of pyonephrosis we have had 2 deaths (5 per cent) in 5 cases of acute suppurative nephritis, 2 deaths (40 per cent). Deaths following our 200 nephrectomies were due to complications that follow surgery anywhere, such as pulmonary or cerebral embolism (2 cases), renal tuberculosis, pneumonia (1 case), pyonephrosis, embryonal adenocarcinoma (2 bilateral renal tuberculosis, 1 pyonephrosis), surgical shock, or cardiac failure (4 cases). One case of pyonephrosis died of carcinomatosis (stomach undiagnosed) following nephrectomy (autopsy). The immediate com-

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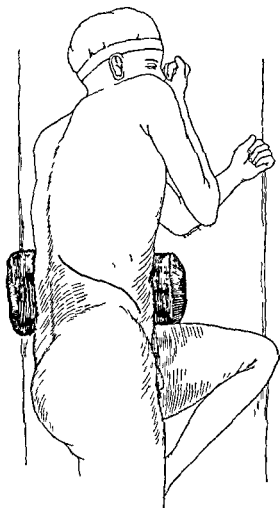


Fig 3

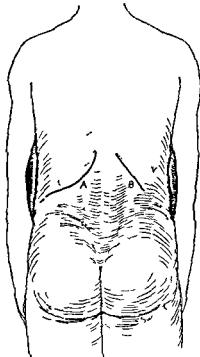


Fig 4

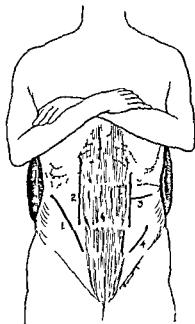


Fig 5

Fig 3 The lateral position of the patient with opposite leg well flexed corresponding one straight arm folded in front and pad under the lower margin of ribs. Usual oblique lumbar incision is shown.

Fig 4 The posterior position of the patient. A Long type of incision for large exposure. B short incision for nephropexy.

Fig 5 The anterior position of the patient for the abdominal route of exposure. 1, The oblique semilunar incision. 2, vertical rectus. 3, the antero-lateral, 4, the inguinal.

plications were especially renal insufficiency (2 cases, bilateral tuberculosis), particularly oliguria and acidosis, hæmorrhage (2 cases, both nephrectomy for hæmorrhage following nephrotomy for stone), and sepsis (2 cases, pyæmia of acute suppurative nephritis), and the local surgical injuries to pleura (7 cases—none fatal), vena cava (none), peritoneum (none), intestines (none), pancreas (none), spleen (none), liver (none), or adrenals (1 case, complete recovery, probably adrenal hæmorrhage, very rapid pulse for 7 or 8 days immediately following operation for renal tuberculosis, no hæmorrhage in wound which was drained). In a properly performed nephrectomy, the utmost precaution is needed to prevent and minimize these renal complications.

Excluding 6 deaths of bilateral and miliary tuberculosis, the two deaths following nephrotomy for stone, in which nephrectomy was attempted as a last resort, the death 2½ months after operation from carcinomatosis and the two pyæmia cases, leaves an operative mortality for all cases of between 1 and 2 per cent.

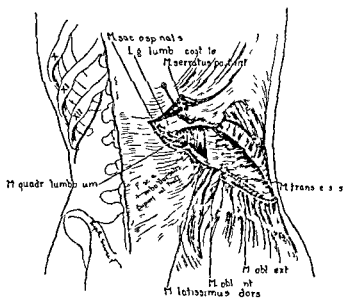


Fig 6 The muscle layers divided by the oblique lumbar incision. First layer latissimus dorsi, sacrospinalis external oblique. Second layer serratus posterior inferior internal oblique. Third layer transversalis quadratus lumborum, costovertebral ligament.

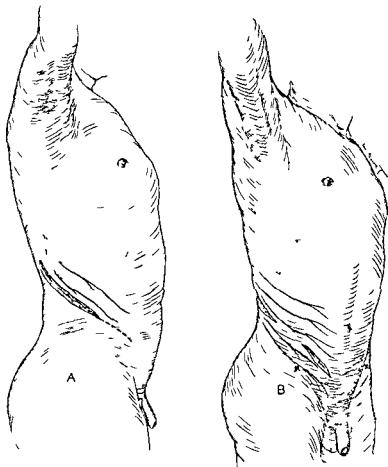


Fig. 7 The general line of distribution of the blood vessels and nerves and how the incision should follow between

One of the most troublesome postoperative conditions following nephrectomy is meteorism. Traction on the renal pedicle may set up nerve reflexes producing temporary bowel stasis or important nerves may be cut or injured by the incision and produce a unilateral muscle paralysis of the abdominal wall. The nephrectomized patient is prone to balloon up full of gas. Rarely is the condition serious but it is often very disagreeable. Purging beforehand is apt to promote its occurrence. It is found less frequently and is of milder degree in patients cleansed by a simple enema without catharsis and given fluids freely up to within one hour of operation. Pre-operative administration of pituitrin or eserine is advised by some.

Oliguria and acidosis are minimized by providing plenty of fluids giving them freely by mouth up to the time of operation by hypodermoclysis

during the time of operation and by rectum or hypodermoclysis or intravenously immediately after. It is our custom to give 500 to 1000 cubic centimeters by needles in the thighs while the patient is on the operating table. This procedure is valuable particularly in children. The urine should be tested for acetone and diacetic acid after operation and glucose and bicarbonate of soda given freely if found. Weeks method enables one to give fluids comfortably per rectum.

#### ANÆSTHESIA

Proper anæsthesia is one of the most important factors of a low surgical mortality. Pneumonia should be a very exceptional cause of death following nephrectomy. The almost universal use of nitrous oxide and oxygen in place of ether or chloroform as a general anæsthetic has contributed largely to the safety of nephrectomy. When a

general anæsthetic is contra indicated, as in pulmonary tuberculosis, a high spinal or paravertebral block is quite satisfactory. When properly given, much better relaxation is obtained than with gas and oxygen. The only objection is its short duration, but this is not serious for the average operation which is well short of an hour. When the operation requires more time, the nerve block can be supplemented by the gas oxygen.

Injury of anatomical structures at the time of operation is best avoided by a thorough understanding of the surgical anatomy involved.

#### THE POSITION OF THE KIDNEY

The kidneys lie in mid back just below the diaphragm in retroperitoneal niches formed by the bodies of the vertebrae, the muscles of the back, and the last two ribs. Commonly the right is somewhat lower than the left (Fig 1), because of the larger right lobe of the liver, and both kidneys are somewhat lower in women than in men (Fig 1, A and B). The relation to the twelfth rib varies considerably because of differing degrees of ascent of the kidneys themselves and of the many variations in length and position of this last rib which may be so short (Fig 1B, left) as to run horizontally and be parallel to the transverse processes, or be wanting altogether. The individual's condition in this respect should be known ahead of operating as a control of the type of incision for exposure, and it is a good rule always to have an X ray picture of the patient exhibited in the operating room. The condition of a twelfth rib is of importance also in its relation to the diaphragm, pleura, and the costovertebral ligament, for frequently free division of this ligament is needed so that the rib can be pulled up out of the way to give good renal exposure. Some surgeons prefer resecting a rib subperiosteally with the purpose of better protection of the pleura. The muscles of the diaphragm are frequently wanting or poorly developed between these points of attachment at the back, particularly when the twelfth rib is short or wanting, so that foreknowledge of the situation is a great help in protecting the rather fragile pleura from injury when the question of division of the costovertebral ligament arises. The usual relation of the pleura to the twelfth rib is shown in Figure 1, the reflection on the left in B would be well below the short twelfth rib on this side. A too high incision—near the eleventh rib—would make injury of the pleura more likely. The variable relations to the kidneys of the abdominal organs lying in front are shown in Figure 2. Injury to some of these rarely occurs and is usually due to catching a part of the organ in a clamp when

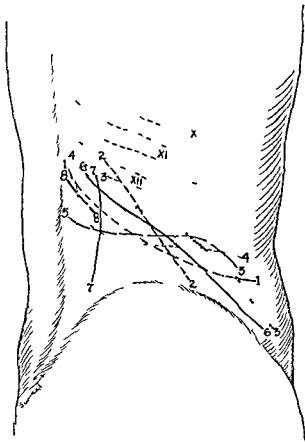


Fig 8. Various types of lumbar incisions that have been used in kidney surgery. 1, Mayo's; 2, Czerny's or Edebohl's; 3, v. Bergemann's or Lissone's; 4, Koeng's; 5, Peon's; 6, Oblique lumbar; 7, Simon's; 8, Superior lumbar triangular.

placed on the pedicle or closed blindly or carelessly to stop bleeding. The commonest accidents of this kind have been injury to duodenum or pancreas which have been caught by the tip of a pedicle clamp. We have had one duodenal fistula as the only injury to abdominal organs and this one closed spontaneously.

#### THE ROUTE OF EXPOSURE

The extraperitoneal lumbar is the route of choice in every ordinary nephrectomy, and the lateral, on kidney pad or mechanical horse, opposite knee fully flexed and corresponding leg straight, is the best position (Fig 3). Where it is desired to examine or treat the opposite kidney, or an exploratory of both is required which nowadays is almost unheard of, the posterior position on pad or horse is preferable to turning the patient (Fig 4). Many surgeons prefer this position (with the anterior) for all operations on the kidney (Kidd of London). My experience with it in several cases has been that it gives a very good exposure. It is particularly applicable for bilateral

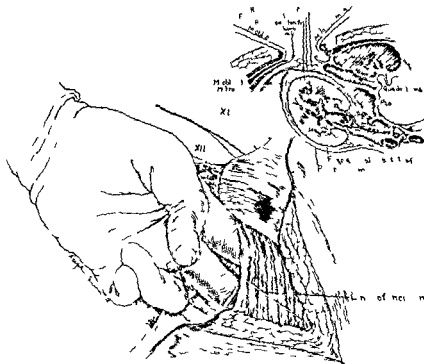


Fig. 9. Completion of the oblique lumbar incision at its abdominal end. Peritoneum stripped from beneath the transversalis held away by two fingers and muscle cut with scissors in line of incision. Insert shows retrorenal fat layer exposed in superior lumbar trigone after the lumbo-dorsalis fascia has been slit open.

nephropexy (incision B Fig. 4). The ordinary incision (A Fig. 4) may be extended down the side and large tumors removed the surgeon working more at the side than above. It is rather hard on the assistant across the table.

The abdominal route (Fig. 5) has advantages over the lumbar in certain cases, particularly of renal tumor. When performed extra peritoneally it is just as safe. Transperitoneal exposure of the kidney carries the added risk of infection and peritonitis. With large tumors it is not always possible to expose them extraperitoneally. By a combined extraperitoneal and intraperitoneal approach as shown by Young<sup>1</sup> these large tumors may be as safely and more radically removed. This, as early advocated by Beer, Quinby and others is the real advantage of the abdominal route. It enables better extracapsular dissection with removal of peritoneum where adherent and cleaner removal of the primary lymph zone about the renal pedicle. It permits more thorough examination of the renal vein for tumor masses and above all the renal vessels may be ligated as the

first step of the dissection, thus minimizing the danger of dissemination as the tumor is being freed as well as securing less risk of hemorrhage. We have found the abdominal route particularly applicable to the removal of large renal tumors in children. The abdominal is also of advantage in complete uretero nephrectomies, but for this operation most men prefer a combined double exposure lumbar for kidney and low inguinal or outer rectus for the ureter, the whole being performed extraperitoneally. In Figure 5 the common incisions used for abdominal nephrectomy are indicated by 1 and 3 for ureterectomy by 1 and 4. Before our present exact methods of diagnosis were known surgeons often elected the transperitoneal abdominal route because it permitted exploration of both kidneys through the one incision.

The abdominal and back musculature and its innervation have to be considered in both the lumbar and abdominal routes. Hernia is the exception after lumbar nephrectomy even when marked suppuration has existed. We have had one case, successfully repaired later. But there are often persistent areas of anesthesia and loss of muscle tonus, allowing unilateral abdominal

<sup>1</sup>Young. Practice of Urology Philadelphia and London: W. B. Saunders Co. vol. II, 1916.

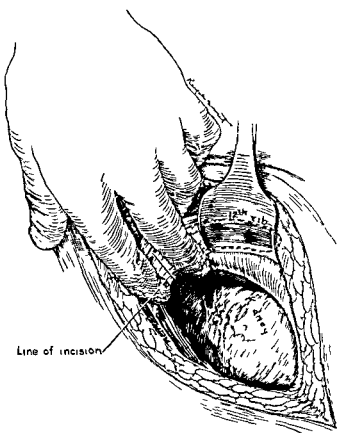


Fig 10 Completion of the oblique lumbar incision at its lumbar end The sacrospinalis and quadratus have been divided in the line of incision twelfth rib put on tension tips of fingers pushing diaphragm and pleura aside so that sharp edge of costovertebral ligament may be felt and cut with tip of scalpel

relaxation which is sometimes quite noticeable In Figure 6 the muscle layers usually cut in an oblique lumbar exposure are illustrated In the first layer are the latissimus dorsi (Fig 6, held up with hook), sacrospinalis and external oblique muscles, in the second, the serratus posticus inferior and internal oblique and, in the third and deepest layer, are the transversus abdominis, and quadratus lumborum with the lumbocostal ligaments between the serratus and quadratus The small area between the outer edges of the sacrospinalis and quadratus lumborum (Fig 1) on the inside, the inner edges of the internal and external oblique on the outside, and the twelfth rib and edge of the serratus posticus inferior above, forms the superior lumbar trigone, the weak space in the back having only the thin latissimus dorsi as covering, and sometimes when this fails to extend down far enough no muscle covering it all One may expose the kidney through this triangle without dividing any muscle fibers but with surgical technique as it is today, good exposure through a wide incision is to be preferred to any method of

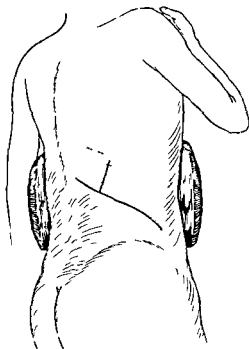


Fig 11 The lateroposterior position of the patient with opposite arm alongside instead of folded with other in front The barn door incision for rib resection is shown

muscle preservation The larger incisions are not mutilating

The nerves of these muscle layers accompany the blood vessels as vein artery nerve from above downward Vessels may be freely cut and ligated as none of them are terminal, but the larger nerves should be preserved, and in the lumbar route are best exposed in the superior lumbar trigone or beneath the latissimus, from which point they may be dissected in both directions They run in the same general direction as the oblique lumbar incision (Fig 7), which has been adopted for the express purpose of nerve preservation, and is most generally used (Fig 8, 6) A great many different types of incision have been advocated for lumbar exposure, some of which are illustrated in Figure 8

The oblique lumbar incision is carried down through all muscle layers to the transversalis, as shown in Figure 7 The fibrous sheath of the lumbo dorsalis fascia (insert of Fig 9) at the superior lumbar trigone is split with a scalpel and its fibers spread apart by blunt finger dissection The course of the 12th, ilio inguinal or hypogastric nerve, any of which may be found running beneath, is next determined and the nerve branches protected from injury By blunt dissection with fingers, as shown in Figure 9 the peritoneum is stripped free from the inner surface of the transversalis, and its fibers are then cut with scissors in the line of the original incision In making



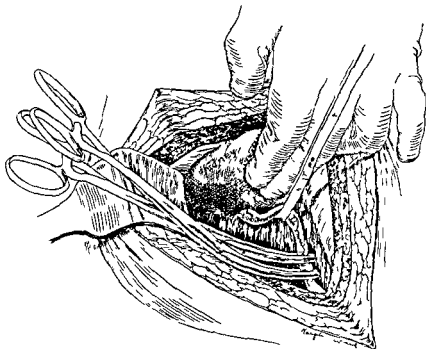


Fig 12 Isolation and division of ureter as first step in delivery of the kidney. Usually not cut until the whole kidney is freed but sometimes in bad infections with adherent upper pole this step gives better access

this dissection where a long incision is desired for better exposure the peritoneum is found some what more adherent the farther one gets from the kidney and unless care is used is easily torn. This is not a serious matter, but the closure of holes in the peritoneum consumes valuable time and sometimes because of the position of the patient and increased intra abdominal pressure closure is a tedious most aggravating procedure. With this end of the incision properly extended one turns to the upper and usually with a normally placed kidney by far more important end so far as good exposure is concerned. The fibers of the lumbodorsal fascia are easily separated by blunt dissection to the borders of the quadratus lumborum and sacrospinalis muscles. When necessary these may be freely divided in the line of incision but the large subcostal vessels and nerves should be protected if possible. One now feels with his fingers deep in the angle of the incision the sharp edge of the lumbocostal ligament. Putting the twelfth rib on tension (Fig 10) accentuates this and with the first and second fingers the diaphragm and pleura may be pushed up out of the way and the ligament divided little by little with the tip of a scalpel along side a finger as a guide up to the insertion of the rib, enabling its

retraction to a horizontal position. Never have we found it necessary to resect a rib in part or whole as practiced generally in France (Marian) nor to extend the incision as is sometimes done for such resection (Fig 11). However we have opened into the pleural cavity (seven times but not all in nephrectomy) an accident it is well to avoid. Empyema developed following one such accident in a little girl who fully recovered. Aside from a few days slight respiratory distress none of the others had any trouble. With the incision completed towels are placed at its edges with skin clips and one proceeds to free the kidney.

#### TECHNIQUE OF REMOVAL

*Extracapsular enucleation* is the method of choice when there is no extensive inflammation infiltration and adhesions to the peritoneum and neighboring organs. The kidney lies above a double fat layer. The outermost retroperitoneal or perirenal fat has been exposed by the previous opening of the fibers of the lumbodorsalis fascia and fascia quadratus lumborum (Fig 9 insert). Beneath this is the posterior leaf of the fascia renalis which is opened by puncturing with the tip of a clamp the blades of which are then separated. The characteristically pale lemon yellow colored fat protrudes,

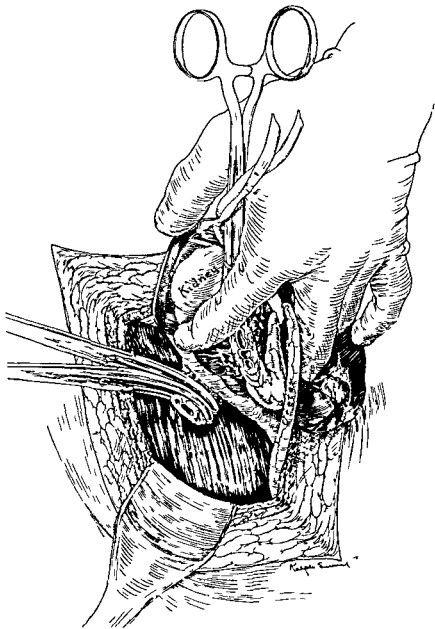


Fig 13 Division of the pedicle before the ureter giving freer dissection of the ureter especially applicable in renal tuberculosis Note position of clamps on pedicle

proof that the puncture is made over the kidney. By gentle traction on the fibrous framework of the perirenal fat with clamps for traction added as the delivery progresses and an assistant's hand pushed under the ribs against the abdomen in front to force the kidney up, it may often be easily delivered without much dissection. At times the fibrous framework between the renal capsule and the perirenal fascia is so well developed that vigorous blunt finger dissection is required to separate them. The ease of delivery will vary. Some kidneys come out best when the lower pole and ureter are isolated and freed first. Then gentle traction on the ureter assists one in freeing the upper pole,

others deliver easily by freeing the upper pole first and, by seizing it in the fingers on a sponge traction can be applied while the fingers of the other hand free the lower pole. By blunt finger dissection, aberrant blood vessels can be located from their pulsation and if necessary ligated and divided. After this, delivery is often easy where before it was incomplete. In renal and perirenal infections, the dissection is somewhat safer and easier if made posteriorly first. The fingers are guided by the back muscles and ribs as a line of cleavage. Once the back of the kidney is freed, one can follow the line of dissection around each pole with less danger of tearing into the peritoneum or

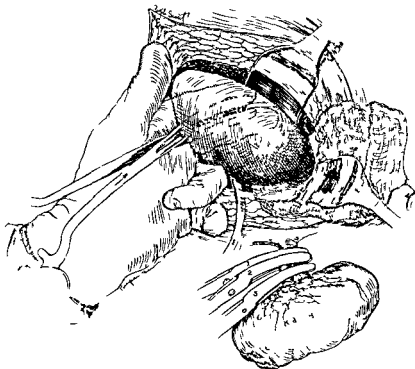


Fig 14 Method of clamping the pedicle The open clamp is slipped down along the fingers clamping the pedicle between them and pushing back peritoneum on neighboring organ so that they will not be caught when the blades are closed

neighboring organs The ureter and renal pedicle (artery and veins) are isolated and the former held up by tape traction It is very rare indeed that the adrenal causes any difficulty Sometimes infection extends to it In one of our cases the post-operative course indicated the possibility of an adrenal hæmorrhage but of this we had no proof

In removing the kidney the choice of dividing first the ureter or the pedicle is governed by the individual situation of accessibility In pyonephrosis with large thickened pelvis and ureter division of the ureter often gives better access to the pedicle (Fig 12) In tuberculous division of the pedicle gives freer access to a greater resection of the ureter (Fig 13)

*Method of pedicle ligation* The writer uses altogether the clamp method of ligation Isolation of artery and veins and their separate ligation without clamps takes more time and in the writer's opinion carries more risk of hæmorrhage than *en masse* ligation on clamps He has been the guest of other men at the time of both accidents a clamp slipped off the pedicle in two instances and a ligature slipped off the artery after separate ligation without clamps in another The hæmorrhage

that results is appalling The bleeding vessel is quickly grasped in the fingers of a hand but safe placement of a clamp on it is extremely difficult It is just such instances that have caused the majority of duodenal and pancreatic injuries at the time of nephrectomy In 200 nephrectomies we have never had a clamp slip nor have we had hæmorrhage from the pedicle either at the time nor after operation We believe that this is due to the kind of clamp used a heavy curved Ferguson clamp with male and female blades which lock so that they cannot slip Another reason is that we always place two of these clamps on the proximal end before cutting (Fig 13) and tie the pedicle with two No 2 chromic gut sutures below each as it is withdrawn the lower one being tied and removed first (Fig 13) In placing the clamps on the pedicle it is extremely helpful if one guides the open clamp blades by the first and second fingers which pinch the pedicle between them and push aside the peritoneum or neighboring organs from the clamp end (Fig 14) This is important for two reasons It makes certain an ability later to catch the suture below the clamp so that it does not engage the clamp when being tied which is not

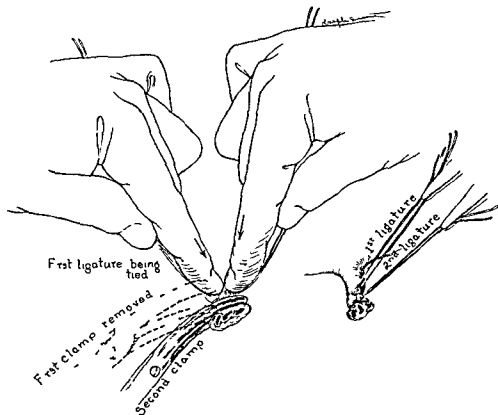


Fig 15 Method of tying double No 2 chromic gut ligature below the first clamp

always possible if the end of the clamp does not project with a free margin beyond the pedicle, and it protects neighboring structures from injury by being bitten in the clamp end. We often use a double No. 2 chromic for the first suture (Fig 15), in order that it may be tied as tightly as possible without likelihood of breaking. The second suture is single. When clamps have not been properly placed, successful ligature may be quite difficult. In only one case have we left clamps on the pedicle without ligature. This was a hurried nephrectomy in a patient of poor condition. The clamps were loosened 48 hours later and then withdrawn after 12 hours. There was no bleeding and the patient recovered. But this method is one of necessity or emergency only and is not safe.

**Method of ureteral ligation.** Ordinarily the ureter is doubly clamped as far from the kidney as convenient, severed with a scalpel and the distal end tied with a single chromic gut suture. In infected cases, we paint the severed ends of the ureter with pure carbolic acid followed by alcohol before suturing. In tuberculosis we sometimes inject the ureteral lumen with carbolic acid by hypodermic puncture before clamping. In some cases the ureter has been severed between clamps with the actual cautery or diathermy knife.

**Intracapsular enucleation** of the kidney is often preferable in advanced calculous pyonephrosis to

extracapsular. Secure clamping of the pedicle in these cases is usually more difficult. The thickened distended pelvis is often adherent and free dissection sometimes dangerous. Catching a part of the pelvis in the clamps rarely occurs, and a

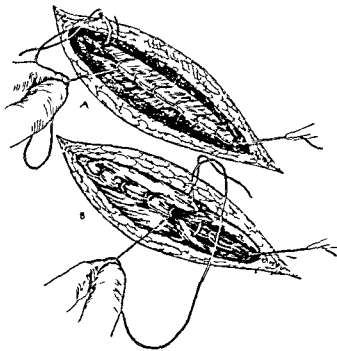


Fig 16 Method of closing the incision by continuous interlocking chromic gut suture

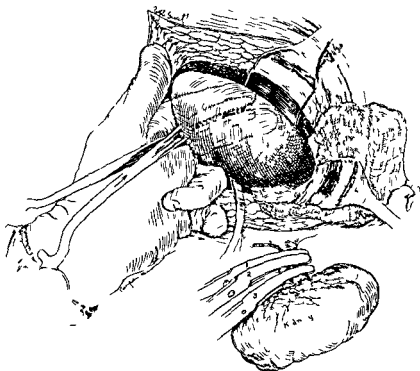


Fig. 14 Method of clamping the pedicle. The open clamp is slipped down along the fingers clamping the pedicle between them and pushing back peritoneum on neighboring organ so that they will not be caught when the blades are closed.

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## FROM THE CLINIC OF THE CITY HOSPITAL OF THE HAGUE

## OPERATIVE TREATMENT OF OBSTRUCTION DUE TO A GROWTH IN THE DESCENDING COLON

By JAN SCHOEMAKER, M D F A C S, THE HAGUE HOLLAND

## FIRST STAGE

THE first stage of the operation for the relief of obstruction due to a growth in the descending colon, is exploratory laparotomy in the linea alba with caecostomy

The skin of the abdomen is washed with a 60 per cent alcohol solution and painted with a 3 per cent solution of iodine. Local anæsthesia of the linea alba and of the ileocaecal area is induced with a 0.2 per cent solution of tutocaine (Bayer) and 1:100,000 adrenalin.

The incision is made 10 minutes after the injection is completed. The two ends of the proposed incision are marked by subcutaneous wheals, made with a very fine needle (Fig 1, A and B). From these two points the entire area is infiltrated, only the two punctures being necessary. We use a 10 cubic centimeter syringe with a long needle and infiltrate the subcutaneous tissues by inserting the needle to a depth of 3 centimeters, partially withdrawing it, and reinserting it until the entire area on both sides of the median line has become infiltrated. After that we introduce the needle into the aponeurosis of the linea alba, infiltrate it with the solution, and then insert the needle more deeply so that it lies between the aponeurosis and the peritoneum. This point is easily determined, because we feel that the needle point has passed a plane of greater resistance. Here 20 to 30 cubic centimeters are injected, the needle being pushed forward, parallel to the abdominal wall, only in the median line. The solution infiltrates both sides and anæsthetizes the peritoneum.

As a laparotomy sheet is to be fixed to the skin, four subcutaneous wheals are made as indicated in Figure 1.

We now go on with the anæsthetization of the ileocaecal region. The best method is a combination of nerve blocking and skin infiltration in a square around the line of the incision.

For the nerve blocking, two points are fixed—the first one near the anterior superior iliac spine, the second just above the first, near the twelfth rib. Between these two points, the whole abdominal wall is infiltrated, so that the eleventh and twelfth intercostal nerves, the lumbar nerve, and ilio-inguinal nerve become blocked. Now we

introduce the needle just under the skin and inject along the area indicated by the dotted line in Figure 2. By the time this has been done, the area first injected has become analgesic.

The incision is made in the median line from about 5 centimeters above to the same distance below the umbilicus through the skin and subcutaneous fat. All bleeding vessels are picked up with artery forceps and ligated with catgut. After the aponeurosis has been incised, a very small incision of the peritoneum is made with a scalpel. This is enlarged at both ends with a pair of scissors, the intestines being protected by a finger introduced into the peritoneal cavity.

*Inspection of the intestines.* The transverse colon can be seen at the upper side of the wound, it is distended. The cotton glove of the right hand is taken off. A few drops of alcohol mixed with soap will make the rubber glove slippery. The right hand, held in the obstetrical manner, is introduced and pushed forward in the direction of the promontory. Here we are sure to find the pelvic rectum. It is narrowed. In the sigmoid we find here and there small tumors that prove to be faecal masses. The descending colon, in which a distinct hardness is to be felt, is found fixed to the parietal peritoneum. The hardness felt is the sharp border between the distended colon above and the narrowed gut below. No metastases are to be found in the mesocolon, peritoneum, or omentum. Next, the hand slips to the liver, but nothing abnormal is to be found.

The abdominal wound is closed with linen thread, continuous catgut sutures being used in the peritoneum, interrupted stitches in the aponeurosis, and continuous linen sutures in the skin. The skin sutures are put in with a straight needle. A thumb is worn on the middle finger. The wound is painted with mastisol and covered with sterile gauze.

An incision about 6 centimeters long, parallel to the rectus muscle, is made into the second area anæsthetized. The broad abdominal muscles are cut (with no division of the fibers), otherwise these after ward would obstruct the colostomy opening.

The peritoneal cavity is opened. Distended loops of small intestine are pushed inward. An

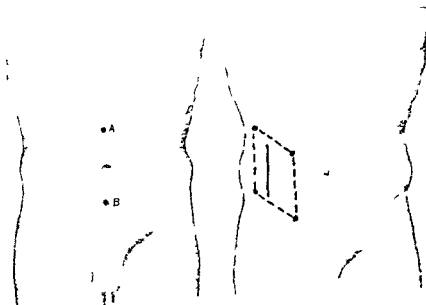


Fig. 1 (left) Dots A and B indicate line of incision. The four outer dots indicate position of subcutaneous wheal for anasthetizing site of forceps to hold laparotomy sheet.

Fig. 2 The dotted lines indicate the line of injection under the skin.

epiploic appendix is removed and a part of the ascending colon is drawn outside of the abdomen. Eight interrupted stitches of fine silk fix the parietal peritoneum to the gut. A second row attaches the muscles, a third one the subcutaneous fat to the intestine. The wound at both sides of the fixed intestine is closed by a few interrupted stitches of catgut. The colon is punctured with a knife, and at the same instant the tube of a sucking apparatus previously brought into position is put against the opening. The liquid contents are removed into a receptacle. Then the opening is enlarged and the tube introduced into the intestine.

When we can be sure that the first flow is safely in the receptacle instead of moistening the field of operation, we put a bandage of gauze and cellulose on the colostomy. The patient is put on a cot and carried to the ward.

Ten days later the patient gets full diet with no potatoes, bread, milk, or rice. Laxatives are given. For 2 days he gets only beef tea and sugar water. After another 2 days the second operation is performed.

#### SECOND STAGE

One hour before the operation an injection of 10 milligrams of morphine with half a milligram of

atropine is given. Ethyl chloride ether narcosis is induced. The colostomy opening is provisionally closed by an impermeable dressing fixed to the skin by means of mastisol.

After disinfection of the skin an incision is made parallel to the outer margin of the left rectus muscle. The aponeurosis of the external oblique is divided in the direction of its fibers. The internal and transverse muscles are cut in their fleshy part so that it will be easier to suture them without endangering the inferior epigastric vessels.

After the incision of the peritoneum is made the opening is enlarged with scissors. Collin's self-retaining retractor is introduced and opened to give a better view of the left abdomen. The growth in the descending colon is now visible and is taken by the assistant and pulled inward (Fig. 3).

An incision is made 2 centimeters to the side of the colon through all the adhesions and the parietal peritoneum, thereby we reach the retroperitoneal space behind the colon and cut with the scissors in both directions upward and downward. The colon now movable is taken out of the abdomen by an assistant. The only fixation of the colon now is the transparent posterior layer of the mesocolon. By turning this to the right we are

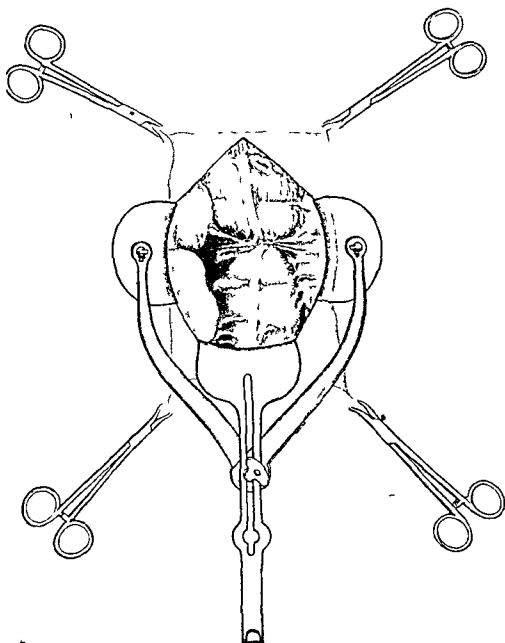


Fig. 3 Collin's self retaining retractor in position and opened permitting better view of left abdomen

able to see the position and course of the mesocolic vessels

Now we cut the mesocolon upward in the direction of the point at which the colon must be dissected, and ligate the vessels near the intestine. When all around it is dissected free, a circular incision is made in the outer layer, the serosa. This is more easy than we might think, for we scratch with the point of a knife along the surface of the colon and push the tissue to both sides. In this way we produce a 5 centimeter sleeve of mucosa plus submucosa. At this sleeve a small clamp is placed, not in the middle, but at the distal portion so that the mucosa is to be seen only at the proximal side

of the instrument (Fig. 4). This clamp cannot be Kocher artery forceps, for they would probably slip after the colon is divided. The clamp must have a deep groove on the inner side, in cross section it should appear as in Fig. 4A. The tissue remaining in the hollow part prevents the instrument from slipping. When this tissue consists not only of mucosa but also of other layers of the gut compressed between the instrument, the chance that it will not slip is greater. The theoretical objection that a strip of muscularis mucosae is brought into the intestinal lumen is of no moment, for tissue between the clamp blades must necrose and will afterward disappear.



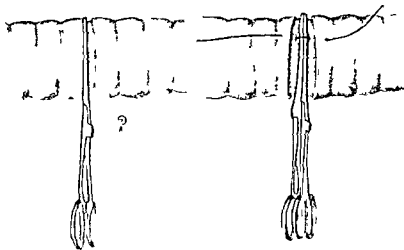


Fig 4

Fig. 4 A small clamp is placed at the distal portion so that the mucosa is seen only at the proximal side of the instrument. 4 Cross section of the clamp showing the deep groove on inner side

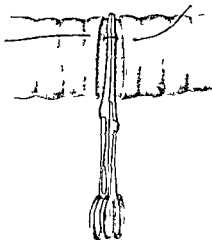


Fig 5

Fig 5 The clamps are brought together and the suture begun

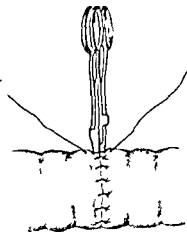


Fig 6

Fig 6 The colon has been turned on its axis and the posterior wall sutured

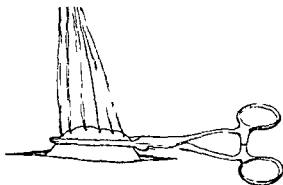


Fig 7 The colon clamp is put on the cæcum just below the provisional suture

Parallel to this clamp a second one is applied so close that a knife blade can just pass between the two. Then the colon is cut. Next the mesocolic vessels are ligated up to the point distal to the growth where the colon will be dissected. Here the same procedure is followed as that already described. The utmost care is taken that the clamp which will close the gut is directed to the same side as the clamp applied first. The best way is to have the points of both instruments directed to the side of the mesocolon. The clamps are now brought together and the suture shown in Figure 5 can be made. We begin at the front and the knots are immediately tied. We take care that the point of the clamps are covered with intestinal

tissue and we now proceed up to the point that is near to the lock of the instrument without putting too much tension on it.

Now the colon is turned on its axis so that the handles of the forceps are turned upward. Thus the posterior wall is in front and the suture can be easily performed. The clamp is now removed. If this should be done without proper precautions the contents of the colon would escape and the possibility of an aseptic suture would be absolutely destroyed. To avoid this a stitch is carried halfway around the forceps (Fig 6) and as the assistant loosens one pair of forceps the knot is drawn and tied by the operator. The same is done when the second pair of forceps are removed and the whole intestine is closed. With a straight needle the second row a continuous serous suture is made. This begins at the mesocolon continues all around above the first row and returns to the starting point.

The beginning and the end of the silk thread are tied together and the opening in the mesocolon is closed by interrupted stitches. The colon is now brought back into the abdomen but on the lateral wall of the colon in the parietal peritoneum is a wound made by incision at the very beginning of the operation. The edge of this parietal wound is fixed by a few silk stitches to the back of the colon near the mesocolon. Then the abdomen is closed with continuous catgut sutures through the peritoneum the transverse muscle and the internal oblique muscle. Interrupted linen sutures

close the external oblique muscle. No drainage is provided. Continuous sutures close the skin. The wound is painted with mastisol and covered with sterile gauze.

The patient is placed on his bed and transferred to the ward. Immediately a proctoclysis is begun with 5 per cent solution of glucose at a rate of 20 drops per minute.

A fortnight later the cæcostomy is closed, the bowels being emptied in the same way as mentioned before.

### THIRD STAGE

After general anæsthesia has been induced, an incision is made at the margin of the mucosa of the intestine, through the skin and the subcutaneous fat. Interrupted stitches are made, the cutaneous margin being turned inside. The cæcostomy wound is closed provisionally. The instruments used during this stage of the operation are taken away, the cotton gloves removed, rub-

ber gloves washed in an antiseptic, and new cotton gloves put on again. The threads of the stitches are not cut but are pulled upward with artery forceps. Then the subcutaneous fat around the cæcum is incised, the adhesions between the cæcum and abdominal wall are cut, and the peritoneal cavity is opened. The cæcum can now be made easily movable. After the adhesions have been cut with a pair of scissors, the cæcum can be lifted out of the abdomen. The colon clamp is put on the cæcum just below the provisional suture (Fig. 7), and the part of the intestine that remains outside the forceps is cut away. The opening in the cæcum is now closed with a clamp. This clamp is substituted by a suture. This suture, a continuous one, is applied directly under the clamp, a straight needle carrying the thread from the right to the left and from the left to the right. When this suture is finished, the clamp is removed, and a continuous silk serous suture closes the intestine. The abdomen is closed in the usual way.

## A STANDARD TECHNIQUE FOR OPERATIONS ON PERIPHERAL NERVES

WITH ESPECIAL REFERENCE TO THE CLOSURE OF LARGE GAPS

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THE great war opened and closed without unanimity of opinion as to many details of the surgery of peripheral nerves. Much experimental work has since been done to establish facts that could have been more accurately established by the thousands of observations made during the war. The exact value and indications for neurolysis, neurorrhaphy and hesage remain to be defined. Experimental evidence has continued to accumulate showing the efficiency of nerve grafting in animals<sup>1</sup> together with reports from clinics showing how useless the nerve grafts usually are in human practice. The remarkable tolerance of nerve trunks to trauma and infection is not generally appreciated. Unnecessary and even harmful nerve flaps or anastomoses continue to be used or resection of long bones performed when end-to-end suture would be entirely feasible. Would the operator but use the full resources of the art. Since evidence of sensory and motor regeneration is so often mimicked by the substitution activities of adjacent nerves and muscles examinations made by those untrained in the field of neurology are unworthy of consideration. But even with this fact established reports continue to be based on written opinions from patients themselves. Our textbooks on surgery continue with illustrations and descriptions of old and useless operations on nerves. If we are to benefit by the enormous experience in neurosurgery of the War it is time that observations were correlated and that standardized methods were formulated and adopted.

If fine silk is the best material for nerve suture why do we continue to use catgut?<sup>2</sup> If uterine ligaments to the nerve sheath do the least harm why follow the transection suture method of Gosset?<sup>3</sup> If causalgia usually subsides when the lesion is corrected why continue to ignore the lesion and to damage the nerve further by injecting alcohol or other chemicals?<sup>4</sup> If end-to-end suture is possible why continue unnecessary and useless nerve grafts?<sup>5</sup> If regeneration is the normal pro-

cedure after nerve suture why not re-explore in any case in which after a reasonable time there is no evidence of regeneration?<sup>6</sup> If a 1.5 centimeter gap in the median or musculospiral nerve can be closed with end-to-end suture why do we continue to substitute less effective or more mutilative procedures for a gap of only 8 to 1 centimeters?<sup>7</sup>

The following suggestions toward a standard technique are based largely on a technical evolution personally drawn from 660 cases of nerve injury.

### TYPES OF OPERATION

Four types of operation only need be considered: exploration, neurolysis, hesage and neurorrhaphy.

*Exploration* is the most important step of any operation upon an injured nerve for upon its finding the character of the needed treatment is determined. Failure to explore the nerve trunk properly has been responsible not only for failures in operative treatment but has produced serious sources of error in the conclusions and statistics of various operators. For example, careful exploration has revealed a definite mechanical obstruction in every one of our cases in which no evidence of regeneration followed the suture of a divided nerve. In our experience, causalgia also means a definite uncorrected and therefore usually an unrecognized lesion of a nerve and it is much more logical to demonstrate and to eradicate the lesion than to use blunt conductivity and stimulate fibrosis in a nerve trunk by injecting alcohol. The exploration to be complete must freely isolate the nerve in all its areas of possible injury, prove that it is the nerve sought, and especially that its component bundles are not subject to interruption or compression. The exposure should be free and if there is any doubt as to the nature of the exposed cord it should be traced to some unmistakable landmark. All points of possible compression and abnormal adhesion should be relieved and the nerve sheath if thickened or abnormal in appearance freely split in the long axis of the

<sup>1</sup> A nerve graft 3 centimeters long in the experimental animal should not be compared with a cat 8 to 10 centimeters long used in human practice. For the short distance necessary may bridge the gap without even penetrating the graft, for the long graft an obstructive fibrosis develops in the lower end of the graft, serving as a downward barrier to block the downward penetration of the axis cylinders.

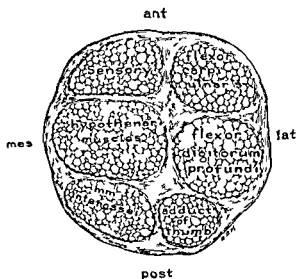


Fig 1 Arrangement of nerve bundles in the ulnar nerve just below the elbow (diagrammatic). By a knowledge of the nerve pattern an accurate diagnosis of a partial nerve injury may at times be made.

nerve. Finally, and of especial importance, the integrity of the contained nerve bundles should be demonstrated. With a thin, nonadherent nerve sheath, careful inspection and palpation is often sufficient. However, when the nerve is adherent, the sheath thickened, and evidence of the condition of the normal bundles obscured, the sheath should be opened freely and the nerve bundles exposed sufficiently to prove their condition. At times, this necessitates a thorough hersage of the entire thickness of the nerve for a distance of 5, 10 or more centimeters. In any case the breadth, thickness, and length of any fibrous or degenerated area within the nerve should be fully explored by sufficient longitudinal incisions in different planes. The amount of intraneural exploration should be based on the extent of the damage found, the technique used being similar to that described for hersage. Not infrequently, lateral, central, or total areas of fibrosis are shown by this exploration which were not clearly evident before the nerve trunk was incised. It is surprising that skilled operators have ignored the importance of intraneural exploration. Because a cord has the diameter and contour of a normal nerve trunk, does not prove that it is a normal nerve. The operator, when clinical examination has shown definite evidence of interruption following injury, has not done his part until he has demonstrated as fully as surgical art will safely permit the integrity of the nerve, both within and without the nerve sheath. To those who contend that the method is too severe, we would invite attention to the relatively slight clinical evidence of

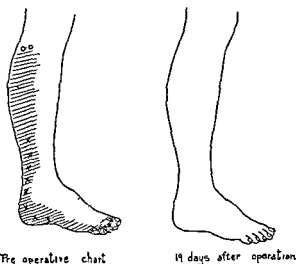


Fig 2 Paradoxical almost immediate return of sensation after suture of a divided peroneal nerve. The anomalous return of sensation was due to liberation of the undivided but compressed musculocutaneous branch. From experience like this the operator may erroneously conclude that regeneration after suture of a divided nerve is possibly within a few days or weeks. Dots indicate loss of tactile sensation; cross lines the pain sensation; crosses the loss of muscle sense.

damage following, through neurolysis and hersage<sup>1</sup>, and to the results obtained in cases where operation without intraneural exploration had or would have failed to give relief.

**Electrical Tests.** Very interesting are conduction tests made with a very fine bipolar electrode and the induced current on the exposed and opened nerve trunk. We have used these tests to determine the possibility of conduction through a damaged area in a nerve trunk, to work out the nerve pattern or the situation and function of the individual nerve bundles, and to locate cor-

<sup>1</sup>Spear and Babcock. Peripheral nerve injuries. Arch. Neurol. & Psych. 1919, Sept.

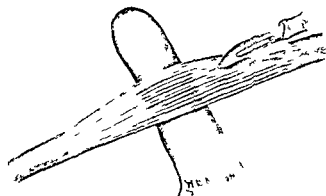


Fig 3 Hersage a nerve fiber disassociation. With a fine very sharp knife the nerve trunk is converted in the area of fibrosis to a flat ribbon of separated fibers.

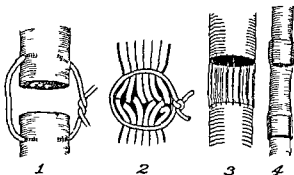


Fig 4 Illustrating faulty methods of nerve suture 1 Undesirable transfixion suture which lies in the path of regenerating axis cylinders 2 Undue tension from transfixion suture displacing the nerve fibers 3 Suture a distance by silk or catgut 4 Use of connecting tubes of hardened blood vessel or other material harmful by interfering with the vascular supply to the ends of the divided nerves

responding bundles above and below the injury as a guide to suture We may briefly summarize our conclusions for chronic traumatic lesions as follows

1 Electrical tests to determine sensory conduction have not been very successful in our experience With the unconscious patient or the patient under a general anæsthetic the guide to sensory interpretation is lost Under local anæsthesia the tests are distressing to the patient or if nerve blocking has been used have an uncertain value Under spinal anæsthesia at times the blocking of the spinal nerve roots is sufficient to prevent shock or severe pain from the tests and yet not sufficient to prevent sensory interpretation

2 Motor tests made by applying the fine bipolar electrode to various parts of the exposed or opened nerve trunk and carefully noting the muscular contractions produced have certain limitations The nerve may be conductive but the muscle from advanced fibrosis and atrophy may be non contractile The nerve fibers may not be interrupted and yet be non conductive as a result of pressure either within or without the nerve sheath The electrical current may radiate from the bundle tested to adjacent bundles or muscles causing contractions that may lead to erroneous conclusions Not infrequently the same muscle or muscle group will respond no matter to what bundle within the nerve the current is applied, so that a correlation of tests of the same nerve in many patients is necessary to determine the nerve pattern After the division of a nerve electrical conductivity is rapidly lost In no case have we been able to prove electrical

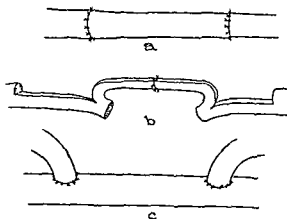


Fig 5 Illustrating methods of neurorrhaphy formerly advocated that have been found as a rule to be useless a Nerve grafting b suture by nerve flap formation c nerve suture by substitution or lateral implantation into an adjacent undivided nerve None of these methods should be used

conduction through a nerve or nerve bundle when the continuity of the nerve bundles was not evident to the naked eye Thus while it might be thought that nerve fibers invisible except by microscopic examination would frequently be present and conduct electrical impulses through a neuroma or other fibrous area lying in the nerve trunk in none of our observations did this occur Nerve bundles that show no macroscopic evidence of interruption may fail to give the electrical conduction reaction but in no case where there was macroscopic evidence of interruption was there electrical conduction In other words careful inspection of an injured nerve gives much more reliable information as to the degree of injury the prognosis and the treatment than electrical tests In determining the topography of an undivided or very recently divided nerve or the function of a branch or bundle the electrical tests have value To indicate the regeneration of the nerve the electrical tests so lag behind the sensory and voluntary motor return that stimulation of the exposed nerve rarely will reveal more function than the patient can demonstrate voluntarily in the pre operative examinations

**Neurolysis** The simplest operation for the interruption of conductivity in a nerve is that to relieve compression from without The nerve may have been strangulated in scar tissue or compressed through fibrosis callus, bone fragments or foreign bodies In one of our cases a Lane plate had been screwed to the humerus over the musculospiral nerve As a rule access to a nerve is obtained by freely excising the old scar The

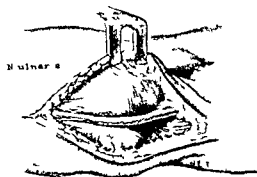


Fig 6 Illustrating the normal elasticity of peripheral nerves. The intrinsic blood vessels where nerves pass around joints are tortuous permitting elongation when the joint is flexed. Ulnar nerve behind internal condyle showing normal tortuous vessels.

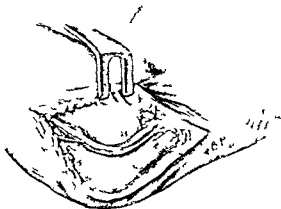


Fig 7 The ulnar nerve on flexion of elbow showing how the vessels of the sheath lose tortuosity from the normal stretching of the nerve.

nerve is first exposed both above and below the point of injury, is carefully freed through the area of compression, injury to the nerve trunk or important branches being avoided, placed in a soft vascular bed, and the wound sutured. In these cases we make it a rule to split the nerve sheath to relieve tension, and to be sure that the contained bundles are uninterrupted, so that a slight heresage has usually accompanied the neurolysis. The nerve is carefully isolated from adjacent bone by interposing muscle or by burying the nerve trunk in a muscle or in an intermuscular plane. No drainage of the wound is required. Causalgia often is at once relieved by the operation, and the patient may notice an improvement in sensation several days after operation. What seemed like a paradoxical, almost complete return of sensation 3 days after suture of the peroneal nerve in one of our cases, was due to the associated neurolysis of the musculocutaneous branch which had escaped division.

Neurolysis may be required after nerve suture to relieve compression that is preventing regeneration. In two of our cases it was found that forming callus led to compression of the nerve after suture. In a third patient, evidence of regeneration rapidly followed after we removed sutures and divided the fibrous sheath at the point of a former nerve suture. From this simple operation of neurolysis 80 per cent of our patients improved within a few months. Thirty three per cent were markedly improved in from 4 to 8 weeks, and some had a complete restoration of function as early as the fifth week.

*Herseage, combing or the disassociation of the fibers of peripheral nerves.* Herseage was advocated in 1907.<sup>1</sup> It is employed when conduction is interrupted by conditions within the nerve

sheath not sufficiently severe to require excision of the diseased segment with end to end suture. Compression from thickening of the nerve sheath, intraneural exudate, limited fibrosis and certain neuromata in continuity are thus treated. The term has been applied to a variety of operations ranging in extent from the splitting of the sheath with one or two slight incisions in the nerve, to a thorough disassociation of fibers throughout the area of disease by which the rounded nerve is transformed into a ribbon of very fine free fibers in continuity with the nerve trunk. We have followed our original technique.<sup>2</sup> "The neurolysis is intended to permit the escape of exudate from within the nerve sheath, to reduce pressure upon individual nerve fibers, to free axis cylinders which have become useless through entanglement in scar tissue, to facilitate the formation of new, or the restoration of old nerve paths, and to stimulate desirable trophic changes in the nerve trunk. A free longitudinal incision of the nerve sheath is made. The sheath should be divided, if possible, well beyond the limits of the lesion. The nerve trunk is then lifted upon one or two fingers or suitable blunt hook held taut, and the nerve fibers carefully separated from each other by means of a small, sharp tenotome. Care is taken to divide as few nerve fibers as possible, although it is aimed to separate freely the nerve bundles from each other. As the operation proceeds, the nerve is transformed from a rounded cord to a flat ribbon like band of separated fibers. If cicatricial tissue is encountered in the nerve trunk, the separation of the fibers is prolonged along straight lines dividing the scar into multiple parallel threads of tissue. During the operation

<sup>1</sup> Babcock. Nerve 1907

<sup>2</sup> Disassociation. Ann. Surg. 1907 xlii 686

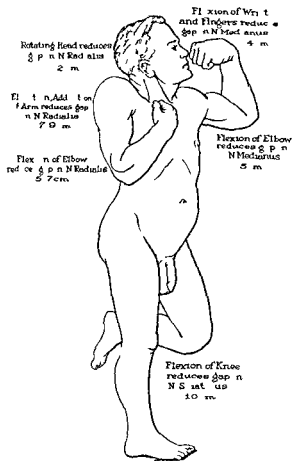


Fig 8 Illustrating positions used in overcoming gaps in peripheral nerves. The length of gap that may be overcome is indicated.

it is important that the nerve be handled gently be not subjected to strong traction and that the knife be sufficiently sharp to separate without unnecessarily pulling tearing or bruising the nerve fibers. This rather severe operation usually does not increase the previous anesthesia or paralysis. In a small number of cases there has been a surprising restoration of function appearing within a few days after operation. While improvement often follows after the hersage of an almost total traumatic fibrosis or fibrous neuroma of a nerve the improvement is rarely complete, and in such cases partial or complete resection of the nerve with suture is to be preferred. When evidence of regeneration does not appear within a reasonable time after nerve suture we would strongly advocate exploration and limited hersage of the area. We no longer isolate the hersaged nerve by fat or fascia transplants but prefer to leave it in a normal vascular bed.

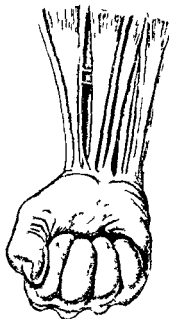


Fig 9 A gap of 4 centimeters in the median nerve may be overcome by flexion of the wrist alone.

*Neurorrhaphy*, or the suture of a divided nerve should refer to but one method, namely an accurate end-to-end suture. *Suture a distance* with catgut silk or other material with or without conducting tubes of Cargile membrane fascia hardened arterial wall or other substance mark the bizarre fantastic stage in the evolution of the suture of nerves as do also substitution sutures nerve flap formation and lateral implantations. These procedures should promptly be erased from our surgical textbooks.

After a nerve has been divided, no other method compares in results obtained with those from the simple end to end approximation of the freshened nerve ends by interrupted sutures of very fine silk in the nerve sheath. If the sutured nerve is now placed in an aseptic vascular bed there is a strong tendency for regenerative changes to follow. An intermuscular plane is the normal and best location for a sutured nerve.

*Gap.* The chief technical difficulty in suturing a divided nerve lies in the distances separating the freshened nerve ends. Gaps of 8 or 10 centimeters have repeatedly led to inadvisable and often useless operations because the surgeon was not familiar with the simple principles that enable large gaps to be overcome. Long bones have been needlessly resected and nerve grafts giving no return of function frequently inserted when

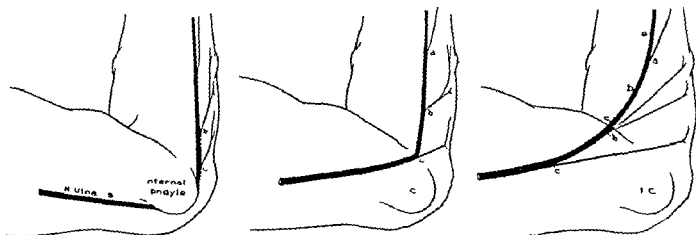


Fig 10 Rerouting the ulnar nerve. Illustrating the greater length of slack to be obtained by splitting the sheath of the nerve and stripping back the muscular branches. This enables the nerve to assume a more anterior position in front of the elbow. *a b c* Muscular branches.

end to end suture without undue tension was entirely feasible. We should standardize the maximum gaps in divided nerves that safely may be overcome by suture in association with the technical methods for overcoming those gaps so that a surgeon may, on ascertaining the length of gap, instantly determine the necessary operative procedure. The gaps we have closed are much longer than those elsewhere given and have aroused the erroneous impression that the nerve must be unduly stretched or traumatized. Gaps are overcome in five ways, as follows:

1. *By the normal slack and elasticity of the nerve trunk.* It has not been appreciated that nerves have a well marked elasticity, stretching and contracting as joints are moved. Evidently this is greater than the elasticity of the accompanying blood vessels as shown by the marked tortuosity of vessels attached to nerve trunks in the vicinity of joints which is largely lost as normal movement puts the nerves under tension. If any of the long nerves be sufficiently freed, a gap up to 3 centimeters may, by the normal slack and elasticity, be overcome without other procedure. Nerves, however, have a limited elasticity and only short gaps are to be closed by stretching the nerve. The distance gained is of course, directly proportionate to the length of the nerve trunk liberated, and it is important to use long incisions and have ample exposure. It is difficult to conceive of a trained surgeon so brutally stretching a nerve as to rupture its fibers or to produce secondary degeneration in the ganglionic cells. The instruments used for holding nerves should be so delicate that they will tear from the nerve before dangerous tension is exerted.

2. *Flexion and extension.* Flexion of the wrist alone will overcome a gap of 4 centimeters in the

median or ulnar nerves. Flexion of the elbow, a gap of 5 centimeters in the musculospiral or median nerves. Acute flexion of the knee will overcome a gap of 8 centimeters in the sciatic or popliteal nerves, dorsiflexion of the foot 4 centimeters, in the anterior tibial nerve, extension of the elbow adds 1 or 2 centimeters to the ulnar nerve, hyperextension of the thigh 2 centimeters to the sciatic nerve, extension and abduction of the foot 4 centimeters to the posterior tibial nerve.

3. *Adduction—adduction or rotation of adjacent joints.* We have found that adduction of the shoulder alone gives sufficient slack to enable one to overcome a gap of 7 centimeters in the musculospiral nerve, and somewhat shorter gaps in the other branches of the brachial plexus. Rotation of the head to the opposite side gives 1 to 2 centimeters additional slack in the cords of the brachial plexus. This may be increased by raising the shoulder on the side of operation.

4. *Rerouting.* By rerouting the ulnar nerve from its position behind the inner condyle of the humerus to the front of the elbow (an old well recognized procedure) and then flexing the elbow, the distance the nerve subtends may be shortened 7 centimeters. By rerouting the median nerve from its deep position at the elbow to a superficial position and then acutely flexing the elbow, about 12 or more centimeters in slack is obtained. By unwinding the musculospiral nerve from the humerus and rerouting to the front of the humerus the distance traversed by the nerve is shortened 3 or 4 centimeters. Rerouting is the most severe of the procedures used, and should not be employed if simpler measures will suffice. With the musculospiral nerve, the damage to the branches





Fig. 11

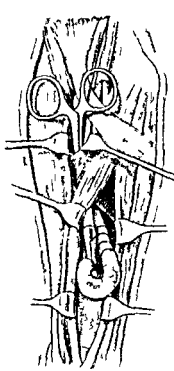


Fig. 12

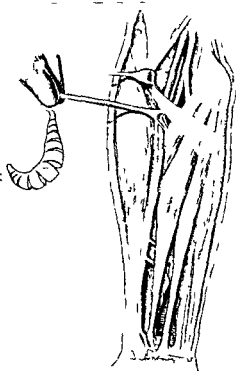


Fig. 13

Fig. 11 Operation of rerouting median nerve below the elbow to overcome a large gap. A large adherent neuroma of the ulnar nerve is shown in solving the lower third of the forearm.

Fig. 12 Operation for rerouting median nerve continued. The neuroma and adjacent portions of the nerve trunk have been freed from adhesions and the neuroma

grasped by forceps passed between the heads of the pronator teres preparatory to withdrawal.

Fig. 13 Rerouting median nerve. The proximal portion of the median nerve has been withdrawn from its deep muscular position at the elbow. The upper muscular branches interfering with displacement of the nerve at the elbow joint are shown.

supplying the biceps is such that it is an undesirable operation. When rerouting a nerve it is desirable that the sheath be slit sufficiently from points where important branches of the nerve emerge so that the branches will strip back and leave the nerve at a higher level and will not be

ruptured or interfere with the transposition of the main trunk. This is especially necessary and somewhat difficult with the median nerve which gives off a number of important muscular branches from its deep position just below the elbow. Our postoperative studies indicate that regeneration occurs but is slower after rerouting and also that muscular branches may be freely stripped back, so as to emerge at a higher point on the parent trunk without interference with their function.

5. *Elongation of the nerve by a two or three stage operation.* In this at the first operation the gap is overcome as far as is possible and the nerve ends united under moderate tension with the nerve at its greatest relaxation by sewing the neuromata together or by suture *à distance*. The nerve trunk is then progressively elongated by gradually extending or otherwise moving adjacent joints. When sufficiently elongated the nerve is again



Fig. 14 Expedients used in liberating median nerves at the elbow. The sheath overlying the muscular branches *a* and *b* of the main trunk of the nerve is slit and the muscular branches stripped back so that they are given off from the main trunk at a higher level. The main trunk is liberated from the restraining branches by the expedients shown in *c*, *d*, *e* and *f*. In this way the median nerve is liberated at a point well above the elbow joint and may be brought to a subcutaneous position.

exposed, the ends freed, the gap overcome and neurorrhaphy performed. One such case occurred in our series in 1918. At the first operation a 7 centimeter gap in the median, and an 11 centimeter gap in the ulnar nerve were overcome in the arm. Several months later when the forearm had been fully extended, an added gap of 10 centimeters of the median and 5 of the ulnar were overcome with end to end suture. In this case the nerves had not been completely divided, but had been raked longitudinally by a bullet traveling parallel with their course and the operations enabled us to resect a total of 17 centimeters of the median and 15 centimeters of the ulnar nerve with end to end suture. This operation rarely is required.

Table I shows the maximum gaps found in our series. In no case was it impossible to overcome the gap, yet because a technique had not been developed, in an early case of the series, to correct a 10 centimeter defect in the median nerve, a graft was used.

**Ulnar nerve.** In the forearm we have found 6.5 centimeters the maximum distance between the nerve ends that may be overcome without rerouting or liberating the nerve above the elbow. This represents the sum of 4 centimeters obtained by strongly flexing the wrist, 1 centimeter by hyperextending the elbow and 1.5 centimeters from the normal slack and elasticity of the nerve. In any gap of 5 centimeters or over the freeing of the brachial portion of the nerve or rerouting should be considered. By rerouting the nerve to a position in front of the elbow and freeing the nerve above the elbow, 6 or more additional centimeters may be obtained, enabling a gap of over 12 centimeters to be overcome.

In the upper arm 5 to 7 centimeters may be gained from the brachial plexus by adducting the arm and 2 to 3 centimeters from the normal slack and elasticity of the nerve, with 2 centimeters from hyperextension of the elbow, making

TABLE I—MAXIMUM GAPS AFTER RESECTION OF NEUROMATOUS AND FIBROUS NERVE ENDS FOUND IN 610 CASES OF NERVE INJURY

Approximate maximum gaps in peripheral nerves expressed in centimeters in which end to end suture is possible

	By slack and elasticity cm	By joint position cm	By rerouting cm	Total cm
Brachial plexus	1.5	3.7		11½
Radial in arm	3	7.5		15
Radial in forearm	1.5	5-4		10½
Ulnar in arm	3	7		16
Ulnar in forearm	1.5	5	6	12½
Median in arm	3	5.7		15
Median in forearm	1.5	4-3	14½	23
Sciatic	3	3-8		14

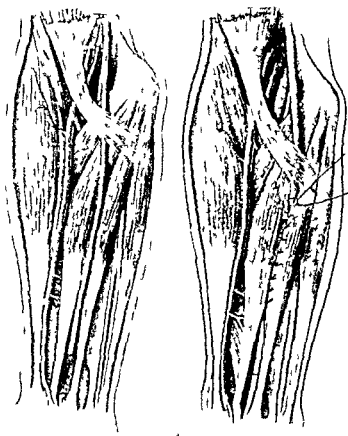


Fig. 15 (left) Rerouting the median nerve continued. The freed proximal end of the nerve is placed anterior to the muscles of the forearm. The intrinsic blood supply of peripheral nerves permits large areas to be separated without secondary necrosis.

Fig. 16 The median nerve is given a thin muscular covering by uniting the radial edge of the palmaris longus to the ulnar edge of the flexor carpi radialis.

a total of 9 to 11 centimeters without resort to transposition of the nerve in front of the elbow. Six additional centimeters are obtained if the nerve is rerouted, making a total possible gain of 15 to 17 centimeters.

**Median nerve.** In the forearm, gaps up to 8.5 centimeters may be overcome by acutely flexing the wrist and elbow and by the normal slack and elasticity of the median nerve. In 1919,<sup>1</sup> by a method of rerouting, we found it possible to overcome gaps of surprising length. This operation enabled us to correct by end to end suture the largest gap we have met in practice, i.e., 15.5 centimeters, while in the adult cadaver we have closed a gap of over 20 centimeters, 4 centimeters by flexion at the wrist, 1.5 centimeters from the normal slack and elasticity of the nerve, and the remaining 14 centimeters by the rerouting and acute flexion of the elbow. In overcoming these large gaps in the forearm, the nerve is exposed from the hand to a point well above the elbow.

<sup>1</sup> Babcock. Neuro Surgical Exchange 1919 May 1.

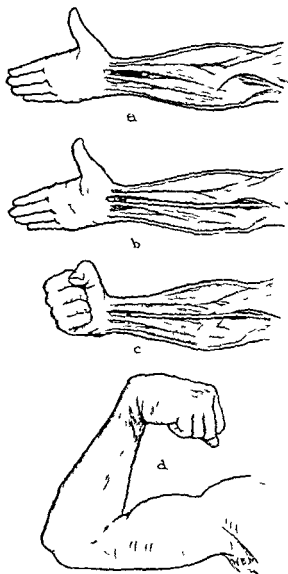


Fig 17 Illustrating steps in the operation for rerouting median nerve showing additional slack which is gained by flexion at the wrist and elbow joints

The proximal end is liberated and withdrawn at the elbow from beneath the deep flexor muscles of the hand and fingers through its tunnel between the heads of the pronator teres.

The muscular branches given off below the elbow to the pronator radii teres, the flexor carpi radialis and the flexor digitorum profundus are now caused to leave the main trunk at points well above the elbow by dividing the overlying

sheath and carefully separating the branches from the other nerve bundles to a sufficiently high point above the elbow to avoid tension when the nerve is transplanted. The main trunk is unthreaded through the loops that are produced in this process. If carefully done the muscle supplied by these split-off fibers retain the power of voluntary contraction after the operation. The diseased ends of the nerve are now resected laid upon the superficial muscles of the forearm and end to end apposition and suture attained by acutely flexing the elbow and wrist. The edge of the palmaris longus is then united to the flexor carpi radialis over the nerve and the skin and subcutaneous fascia carefully sutured. The operation is based on the much shorter arc subtended with the flexed elbow when the median nerve is transplanted from its normal deep to a superficial position just below the elbow.

In the arm as with the ulnar nerve 5 to 7 centimeters of slack may be obtained from the brachial plexus by adducting the arm and elevating the shoulder 2 to 3 centimeters by the normal slack and elasticity of the nerve and 5 centimeters by flexion of the elbow joint without rerouting a total of 13 to 15 centimeters. Obviously the rerouting or transplanting of the median nerve in the forearm to overcome defects above the elbow is not practical without division of muscles or of important nerve branches.

**Brachial plexus** By turning the head toward the opposite side elevating the shoulder and carrying the arm forward in adduction gaps up to 10 centimeters in the brachial plexus may be overcome.

**Sciatic nerve** With this large nerve we have closed a gap of 13 centimeters. Two centimeters are obtained by hyperextension of the hip 3 centimeters from the normal slack and elasticity of the nerve and 8 centimeters by acute flexion of the knee. By a more extensive liberation of the nerve toward the pelvis and below the popliteal space a slightly greater distance may be overcome.

**Anterior and posterior tibial nerve** By using the slack obtained by liberating the lower portion of the sciatic and popliteal nerves and by flexing the knee 6 centimeters may be gained for the anterior tibial and 8 centimeters for the posterior tibial nerve plus 1 or 2 centimeters from the normal slack and elasticity of the nerve. With the additional distance of 4 centimeters gained by dorsiflexing the foot for the anterior or plantar flexing and adducting the foot for the posterior tibial nerve it is evident that a gap of from 13 to 15 centimeters long may be obliterated in these nerves.

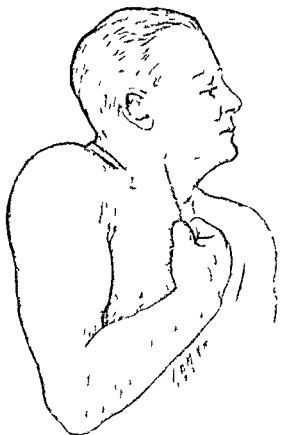


Fig. 18. Illustrating method of obtaining slack in the brachial plexus. The arm is adducted, the shoulder elevated and the head turned toward the opposite side giving a slack of 7 to 9 centimeters in the plexus of the adult.

**Radial (musculospiral) nerve.** A slack of 7 centimeters is produced in the upper end of the musculospiral nerve by carrying the arm forward close to the chest. This slack is not evident until the nerve is gently liberated from its attachments as it winds back of the humerus after leaving the brachial plexus. In the lower arm, 5 centimeters additional may be obtained by acutely flexing the elbow and adding 2 to 3 centimeters for the normal slack and elasticity of the radial nerve in the arm, it is evident that end to end suture is possible with a defect of 15 centimeters. It is difficult to conceive of a defect of more than 15 centimeters in the radial nerve of the arm without destruction of the arm, and the few centimeters additional that may be gained by rerouting the nerve to the inner or anterior face of the humerus, should rarely be necessary. In one instance we rerouted the radial nerve to the inner side of the humerus before discovering the abundant slack to be obtained at the shoulder. In this case it was very difficult to transplant the nerve from the back of the humerus without damaging important muscular branches. In the forearm

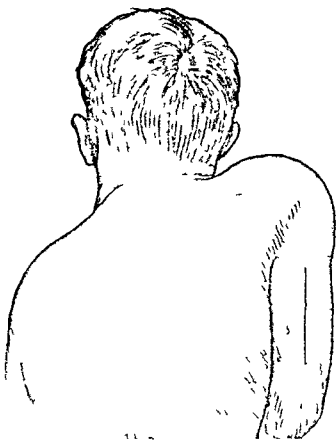


Fig. 19. Incision for exposing the musculospiral nerve in the upper part of the arm.

defects in the radial nerve and its branches up to 10 to 15 centimeters may be overcome by flexion at the elbow, extension of the wrist, and taking up the normal slack in the nerve.

#### TECHNIQUE

The overcoming of large defects in peripheral nerves for end-to-end suture is only possible when certain expedients are used. The surgeon who operates with a limited exposure is doomed to failure. Very long incisions are necessary, and if possible, they are so planned as to include the excision of old scars. An incision even from the shoulder to the wrist may be made, and after accurate closure of the skin and subcutaneous tissue leave a fine linear scar. Through the excision of the previous deforming cicatricial tissues, the liberation of adhesions, the mobilization and replacement of muscles, a marked cosmetic as well as functional improvement is usual despite the length of incision used. An exception must, of course, be made in patients with a tendency to keloid formation.

The nerve is very freely exposed well above and well below the site of injury and then followed into and liberated from adhesions and scar

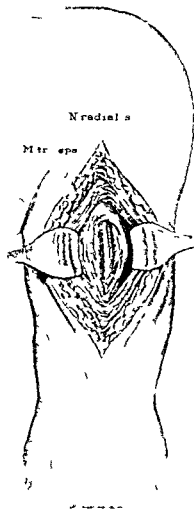


Fig. 20. Musculospiral nerve exposed between the heads of the triceps.

Having determined by exploration the amount of resection of the nerve ends necessary to obtain well formed fasciculi, the gap that will remain is measured and the expedients necessary to enable end to end union computed. To take advantage of the normal slack, elasticity and the relaxation produced by joint movement the nerve must carefully be released from its adjacent attachments. If the nerve passes through or under important muscles these are not divided but the nerve is mobilized by smooth round ended scissors or hæmostatic forceps which are passed along the nerve and gently opened until the nerve may be slid in the canal as careful traction is made on it. To obtain the full effect of flexion or other position at joints it may be desirable to place the nerve in a more superficial position

and to divide partially an overlying annular or other restraining ligament. If the movement of the nerve is restricted by important branches the nerve should be mobilized as previously described. Patience, gentleness, ample exposure and accurate anatomical knowledge are most important.

*I could make it a rule to which there are rare exceptions. If the gap in an important peripheral nerve cannot be overcome without nerve grafting or resection of bone then the part will be found so disorganized that a nerve suture will be useless and unnecessary. As a corollary: A graft or bone resection to enable nerve suture usually indicates that the operator has failed to use the full resources of his art.*

With a bony ankylosis a fracture involving the joint or an arthritis, end to end suture may be impossible without involving the associated lesion. A loss of nerve function may be preferable in rare cases to a disturbance of the bone or joint condition and the surgeon may compromise by a probably ineffective nerve graft. The importance of an early union after the division of a nerve is recognized. With chronic infection of soft tissue or bone the delay of many months for healing to occur and three or more months after healing for any latent infection to subside may lead to serious or permanent degenerative change in the nerve. Peripheral nerves with their peculiar intrinsic blood supply resist infection better than many other tissues and to avoid a harmful delay

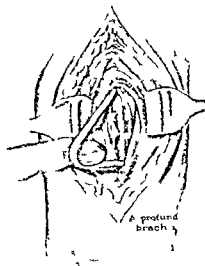


Fig. 21. Illustrating the slack of 7 centimeters obtained in the musculospiral nerve by adduction of the arm.

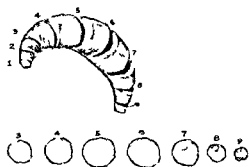


Fig. 22 Neurorrhaphy. Exploration of a neuroma in continuity. The central portions (5) show on section complete fibrosis. At 3 and 6 the trunk is enlarged and hyaline. At points 2 and 7 a nerve bundle is found. The transverse sections are continued a sharp razor being used until normal brush like ends with absence of fibrosis are found at 1 and 9 at which points the neuroma is excised.

we have sterilized the suppurating wound with a solution of zinc chloride as elsewhere described,<sup>1</sup> operated on the injured nerve and have sequestered it in, or between healthy muscles. In one such case with ununited fracture and extensive suppurative osteomyelitis of the humerus following gunshot wound, regeneration with return of power to the brachioradialis and extensors of the hand, occurred within the usual time and there was no evidence of irritation or infection of the sequestered and sutured musculospiral nerve. With insufficient adjacent healthy soft tissue to surround the newly sutured nerve, as with a destructive arthritis, it may be impossible to protect the nerve and delay until the infection is overcome is necessary.

**Neurorrhaphy.** In suturing a divided nerve, the ends are sliced back to a point where nerve bundles may be recognized everywhere within the sheath. The ends are trimmed square and accurately united. Usually after an old injury, the nerve ends are found bulbous or neuromatous, especially the proximal end. On section, the bulbous ends are found to be fibrous, and give no gross evidence of fasciculi. Next to the fibrous zone is an area in which the nerve bundles are apparent, but are oedematous or hyaline and fused together, and the diameter of the nerve is increased. This area of chronic neuritis may be very short or may extend a considerable distance along the nerve. Distal to the zone of injury, both above and below, normal appearing nerve bundles are found. The bundles are discrete, not fused, and on section separate slightly from each other and project from the cut surface, giving a stubby brush end appearance. The nerve trunk may be swollen and larger than normal and have a

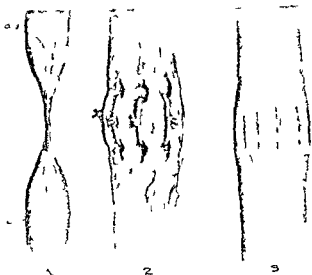


Fig. 3 Illustrating the reaction in peripheral nerve trunks from suture material. 1. Sciatic nerve united by suture a distance with a large braided silk suture 5 months before. No reactionary degeneration of the nerve has been produced by this large non absorbable suture which was introduced when the wound was debrided for gunshot injury in France. 2. Showing pockets of liquefaction and absorption in the median nerve from a neurorrhaphy with chromic catgut performed 4 months before. The wound was free from infection and while no abscesses were present the sutures have produced marked destruction of the nerve ends. 3. Fine black silk sutures uniting the median nerve shown after 5 months. Absence of destructive action upon the nerve is evident. Catgut should not be used.

slight yellowish tinge from fatty degeneration. The first fibrous zone bars the downgrowth of axons, and should be excised freely. Regeneration may take place through the second zone, and when there has been a widespread neuritis, it may be the only portion available for suture. While we have selected by preference the more normal third zone when the length of the gap did not preclude, the influence of the chronic neuritis of the second zone on regeneration has not been fully determined. The degree of neuritis at the point of suture with the degree of hyaline change in the bundles, and the diameter of the nerve trunks and nerve ends in millimeters should be recorded. If there has been a marked neuritis, and regeneration is not evident in a reasonable time, reoperation, excision, and resuture always should be considered.

The adjacent liquefaction necrosis and marked leucocytic infiltration produced by catgut is such that it should not be employed for nerve suture. In Figure 23 the pockets of leucocytic infiltration, liquefaction and absorption about five chromic catgut sutures are well shown. The catgut had been introduced several months previously. No other evidence of irritation was found about the healed nerve. In contrast we found no

<sup>1</sup> Babcock. The immediate sterilization of wounds. J. Am. M. Ass. 1910 LXXIV 1301.

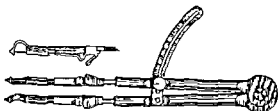


Fig. 24 Nerve clamp for holding peripheral nerve during suture. The nerve end and are transfixed by a very fine needle or steel pins and are gradually brought together as the nerve is freed. The clamp greatly shortens the time for suture and prevents displacement and disorientation of the nerve ends.

such local reaction about either fine or coarse sutures of silk that had been introduced in nerves. That chronic catgut is occasionally so harmful is enough to banish it as a nerve suture. Especially undesirable may be the zone of degenerative reaction produced by the transfixing suture used in the technique of Gosset. The argument that a transfixion is necessary to prevent cupping of the nerve ends and a failure of opposition of the central fasciculi has little practical basis. On the operating table we found little tendency toward a central cupping after suture of the nerve sheath alone and a central separation of 1 or 2 millimeters filled by aseptic blood clot is no bar to the down growth of neuraxones and may even be an advantage in better permitting the down growing axon cylinders more accurately to select the nerve bundle into which they properly should advance. A light contact of the nerve ends is to be preferred to a tight suture by which the nerve bundles are turned back or driven past each other.

Fine black sewing silk from No. 0000 to size A of good quality is sufficiently strong to suture the largest nerve and if aseptic produce very little reaction. We prefer many fine sutures to a few coarse ones. Fine arterial suture, however, is too delicate to suture any but the finest nerve branches. A straight No. 10 or 12 bead threading needle of short length as is used in arterial suture, is preferred; a mosquito haemostatic forceps being used as a needle holder. The suture penetrates the sheath but not the nerve substance and the number of sutures employed varies from 4 for a small nerve like the musculocutaneous or internal saphenous to from 20 to 35 interrupted sutures for a large nerve like the sciatic. In suturing three or four guide or location sutures are introduced at nearly equidistant points and then a sufficient number of intermediate sutures to give sufficient support. Intraneural suture is not very feasible or desirable. Care is taken to keep the edges of the nerve sheath everted so that no portion will

be interposed between the fasciculi (Figure 24). The suturing is greatly facilitated by using a nerve clamp (Figures 24, 25, 26) which orients and holds the ends accurately together, facilitates the rotation of the nerve during suture and relieves the early sutures of tension.<sup>1</sup> If undue force is used in attempting approximation by the clamp the delicate holding pin will tear out or the nerve will be distorted. While the instrument removes all slack under light traction it will not injuriously elongate a nerve. As the nerve is freed the slack is taken up by tightening the instrument and the full effect of position and liberation of the nerve instantly shown. The union following suture of a nerve rapidly becomes strong not so much from the early end-to-end union as from the adhesions that quickly form to adjacent muscles and other soft tissues. In a sutured sciatic nerve re-examined 20 hours after suture we found such firm fusion with the adjacent muscles that the line of union showed no strain when moderate force was applied to extend the knee. In this case soon after end-to-end suture for a 12 centimeter gap the patient had extended the thigh and we believed had torn the nerve ends apart. In a second case when the ward surgeon forcibly extended the elbow 2 weeks after suture for a long gap in the median nerve the adjacent adhesions were so strong that the nerve ruptured above but not at the suture line. The fusion with adjacent tissues is so marked that we have found it difficult to isolate a nerve trunk a few weeks after operation. In time the adhesions become less marked. A sutured nerve will not remain under tension; it will elongate or the line of suture give way. Elongation without damage to conduction rapidly occurs. Recall for example the very marked elongation of a sensitive seventh nerve by certain rapidly growing subcutaneous tumors with out facial palsy.

*Elongation of a nerve after operation.* The nerve is caused to grow longitudinally after operation by graduated and progressive movements of adjacent joints. The range of movement of the joint is increased two degrees on a measured arc each day beginning 7 days after the operation. Thus if it has been necessary to flex the elbow to an angle of 90 degrees to obtain end-to-end suture of the median nerve on the seventh day the restraint is so loosened as to permit movement to 92 degrees on the eighth day to 94 degrees and 45 days later the elbow should be straight or at 180 degrees. This arbitrary rule which we adopted 6 years ago has in practice proved entirely safe. As would be expected the regeneration will be

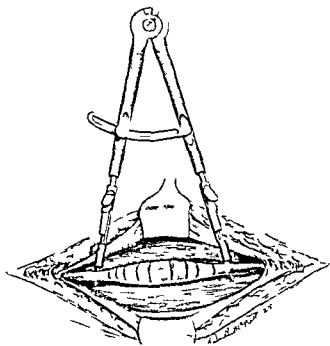


Fig 25 Nerve clamp pinned to nerve distal to a neuroma in continuity which is being explored

slower when the nerve has to elongate as well as to regenerate

*Causalgia* may be due to adhesions, to compression, to a neuroma terminal or in continuity or to a neuritis. A neurolysis, herstage, or even a resection and suture may be necessary. In neuritis a division of the sheath and limited herstage is useful. In one marked case with involvement of the sciatic, the nerve had been injected with alcohol several times without relief, but the pain promptly subsided when an overlooked neuroma in continuity was excised and the ends sutured. With partial division or obstruction in a nerve, it is wise to split off the injured from the functioning fasciculi and to do a partial or *measuring worm* suture as indicated in Figure 28.

A knowledge of the nerve pattern, Figure 1, is useful in partial suture and also in locating a partial obstruction. For example in a case of paralysis of the flexor carpi ulnaris only, the roentgenogram showed a minute shell fragment in the region of the ulnar nerve near the elbow. As fasciculi for the flexor carpi ulnaris run in the anterior mesial segment of the nerve, (Fig 1), in this case there was reason to believe that the fragment was imbedded in the anterior inner quadrant of the nerve, precisely where it was found at operation. A study of the nerve pattern also may be of value in locating the position of the fasciculi that are blocked, where there has been a partial return after performing suture.

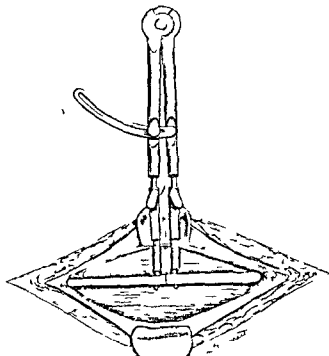


Fig 26 The neuroma has been removed. The nerve ends accurately apposed by closing the nerve clamp are in position for suture. The under surface of the nerve is exposed by rotating the clamp.

The speed of regeneration down a nerve from the line of suture is about 1 millimeter a day or 1 inch a month. The downgrowth of certain sensory neuraxes is more rapid, so that deep pressure tingling (Tinel's sign, a pins and needle sensation where the skin over the nerve trunk is tapped distal to the injury) is in advance of the pain, tactile sense, and motor return, and usually indicates that they will follow in some degree at least. If no evidence of regeneration has occurred after twice the normal period of time has elapsed, the nerve should be re-explored by operation. For example, the radial nerve has been sutured 100 millimeters (4 inches) above the belly of the brachioradialis. Normally in 4 months, or 100 days, faint voluntary contractions of this flexor should appear. If, despite appropriate support to maintain relaxation of the affected muscle and massage, no voluntary contraction appears after 8 months, we would re-explore the area of suture, free the nerve cord, remove sources of pressure, split the nerve sheath through the zone of anastomosis and withdraw any visible sutures. We have seen a very rapid return of function after such secondary operation. Pressure from scar, or new callus, irritation from sutures, or other foreign bodies, evidence that the nerve ends were not sufficiently resected to remove all fibrotic or degenerative tissue, or, actual separation of the nerve may be found. In our series, if the divided



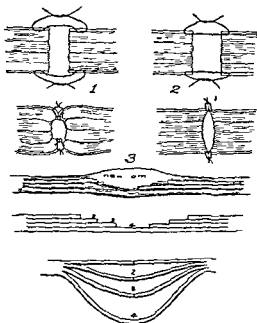


Fig 27 Methods of nerve suture 1 Faulty method of suture of the nerve sheath producing inversion so that the sheath lies in the line of growing neurax 2 proper method of suture of the sheath with fine silk, producing inversion 3 or 3 millimeter separation of the nerve end is desirable to facilitate orientation in the downgrowth of neurax 3 Neuroma in continuity showing step resection without complete division of the nerve This method enables any residual function of the nerve to be conserved

nerve was sutured within 1 year from the time of injury and there was no evidence of regeneration after the stated interval exploration invariably gave a reason While early nerve suture is desirable a suture 1 year or more after the injury although less promising should as a rule be tried

The results after operation upon nerves with 1 simple function as the musculospiral or posterior tibial are of course much better than those upon nerves of complex function such as ulnar and anterior tibial Possibly many of the partial results reported are due to technical errors as failure to match the nerve bundles in the end to end apposition degenerative area in the nerve produced by catgut or transfixion sutures failure to remove all neuromatous or degenerated tissue an associated neuritis muscle fibrosis or other cause In two instances ineffective operation had resulted because performed for a lower and minor lesion while the major and higher nerve lesion had been overlooked

#### SUMMARY

1 It is desirable that the technique for operations on peripheral nerves be standardized not only to give the patient the greatest benefit from

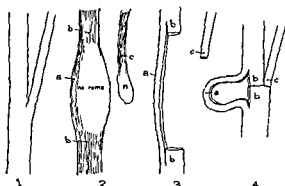


Fig 28 Illustrating method of suture for neuroma in continuity 1 Nerve with branch before injury 2 a Nerve trunk with neuroma in continuity b Separated branch with terminal neuroma n 3 Illustrating section of neuromatous tissue Branch showing at c 4 Measuring worm type of suture with union of branch c to the distal end of the nerve

the operation, but to provide a uniform basis for evaluating and comparing the results from exploration neurolysis herbage and suture

2 An exploration should include the contents of the nerve sheath Neurolysis also should include the opening of the nerve sheath herbage a careful dissociation of the nerve fibers throughout the field of injury neurolysis an end to end matching of nerve bundles the approximation being by fine silk introduced in the sheath only without transfixion of the nerve and without the use of catgut or other exudate producing sutures

3 A sutured or injured nerve should be placed in a normal intermuscular plane or buried in living muscle Insulation of the section of nerve from adjacent sources of blood supply by caryle membrane arterial tubes or tissue transplants not only interferes with the nutrition of the damaged nerve but invites injurious local exudative reaction and absorptive processes

4 Nerve grafting to bridge defects in peripheral nerves should be considered useless and unnecessary and as such should take its place with such discarded operations as suture at distance substitution and flap formation As a rule the operator who resorts to nerve grafting should realize that he has probably failed to do what could have been done that he has failed to avail himself of the full resources at his command If it is impossible to bring together and suture divided nerve ends then the limb usually will be found so disorganized that suture would be valueless

5 Gaps much longer than heretofore thought possible may be closed without undue tension by end to end suture

BILATERAL RESECTION OF THE MANDIBLE FOR PROGNATHISM<sup>1</sup>

By LOUIS SCHULTZ M D CHICAGO

From the Department of Oral Surgery University of Illinois

**P**ROGNATHISM (*pro* in front of, *gnathos*, jaw) is a comprehensive term used to define various malformations of, or malrelations between, the upper and lower jaw. Moorehead and Dewey (13) differentiate between physiological prognathism, an ethnological peculiarity, in which both jaws protrude, but there is normal occlusion of the teeth, and pathological prognathism characterized by protrusion of but one jaw and by abnormal occlusion of the teeth. The latter term includes facial deformities distinguished by a retrusion of either jaw with a real or only an apparent protrusion of the other. It also includes cases in which one jaw is normal the other protruding and finally cases of "open bite" with occlusal relation between the molars, sometimes the last molars only, all other teeth failing to meet.

For the sake of conciseness, this article is limited to the type of prognathism for which I operated, in the report of which I am describing and illustrating the technique used. This relates to a normal upper jaw with a protruding mandible and open bite. These cases are rare—hence the literature is not abundant. Yet, as Brophy (4) says when extensive they belong to the most conspicuous and repulsive deformities of the face.

The etiology includes thumbsucking and similar bad habits in early childhood, enlarged tonsils, adenoids, mouth breathing, lack of dental care, especially that relating to the permanent first molars, resulting in a faulty bite. This may induce abnormal use of the muscles of mastication, the resulting stimulation causing overdevelopment of the jaw and failure of normal formation of its angle. Heredity may be a potent factor, so is atavism. The deformity may be an expression of certain diseases, such as rickets, acromegaly, cretinism, partial gigantism, etc., or it may be the result of trauma as when, after a fracture, union of misplaced fragments is permitted. Blair (3) also points out that contracting scars from burns on the neck and chin can greatly deform the developing jawbone.

The diagnosis is made on sight.

The prognosis varies. Mild cases in young individuals usually can be successfully cared for by the orthodontist. Certain adult cases can be corrected by surgery. In such, the prognosis is good. In others it is only fair.

Treatment relates to the use of appropriate orthodontic appliances, traction on the protruding chin at night by means of a headcap and chin strap when indicated. In older patients however, after the bones have hardened, surgery offers the only means of correction.

The first surgical operation on record for such a case was done by Hüllihen (11) in 1848.

Babcock (2), of Philadelphia, has corrected this deformity. He did it by section of the ramus followed by wiring the teeth in occlusion.

But to V P Blair of St. Louis, belongs the credit of first conceiving the plan to correct such deformities by shortening the body of the mandible by bilateral resection. He proved the soundness of his concept by successfully performing the operation, making all interested surgeons his debtors, an obligation which I freely acknowledge. His operation consists in removing a suitable section in the second bicuspid region on each side and adjusting the anterior segment to the posterior ones. They are immobilized by wiring the fragments together and the lower teeth are fastened to the upper ones either by wiring or by an appliance cemented to the teeth. He has performed this operation more often than any one else.

Harsha (9, 10), of Chicago, in 1912 reported a case which he corrected by removing sections from the body of the mandible at the angle, preserving the nerve.

Gilmer (8), of Chicago, in 1915 reported a case of upper retrusion with lower protrusion. He removed sections at the angle reducing the enlarged mandible to normal size and secured an ideal surgical result. He does not state whether



Fig. 1. Photograph of patient before operation.

<sup>1</sup>Read before the Chicago Medical Society, May 26, 1926.



Fig. 2 Impressions of patient's mouth before operation



Fig. 3 Roentgenogram of teeth

or not this was followed by an orthodontic correction of the retruded maxilla but if it was it must have resulted in a perfect profile.

Aller (1) resected a V shaped piece in the second bicuspid region on each side intra orally with good result.

Gessner and DeVerges (7) reported a case done under local anesthesia after Blair's method. With a metacarpal saw sections were made through the bicuspid sockets and the reduction of chin and anterior teeth accomplished.

Pichler (15) mentions Blair and others who operated on similar cases and comments on their technique. He operated under local anesthesia, conductive type, doing a submucous resection.

Floris (6) of Hamburg reports a case successfully done by Kuemmel. The deformity was corrected by a unilateral resection. He intended doing the operation in two steps. However, union of fragments was delayed and complicated

by repeated breaking of wires used to immobilize the fragments. The patient refused a second operation, declaring herself satisfied with the result of the one operation.

Pickernill (14) removed a section in the first bicuspid area, doing one side at a time but did not get a perfect result.

Dufourmentel (5) calls attention to the dangers of the correction by bilateral resection of the body. He recommends as best his operation of double resection of the condyles and reports 5 cases he corrected this way since 1917. There is no fracture of the body, no danger of ankylosis and motion is not impaired. But the teeth cannot be brought into occlusion though the protrusion is reduced. The open bite must be corrected by orthodontic means.

Julliard (12) reported a case of double resection before the French Surgical Congress. He did it extra orally under local anesthesia, making some cuts with a Gigli saw and some with a circular one. He reports good esthetic and functional effect.

It seems that each operator has adopted a technique which varies somewhat from that practiced by others. I also have found it expedient to do this.

A report of my case follows.

Ms. C. C., age 19, referred to me by Dr. R. C. Will of Ironton about 2½ years ago. The mother died of tuberculosis and other members of family are tuberculous. Patient had rickets and diseases of early childhood. Later

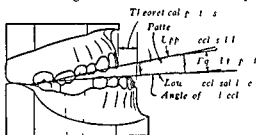
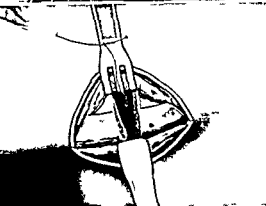
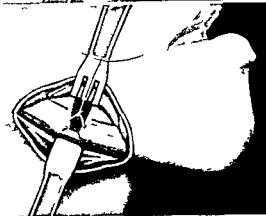
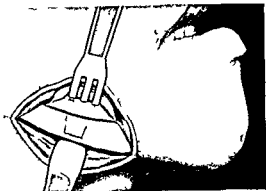


Fig. 4 Diagram showing scientific manner of preparing patterns for correction of deformities of this nature.



Figs 5 6 and 7 Technique of removing segment of bone

at three different times she sustained long bone fractures during play from falls which in a normal child would not have resulted in any serious injury. Patient suffers from an inferiority reaction rapidly leading to manic depressive psychosis with depressed phase.

Examination shows an emaciated patient suffering from anaemia (Fig 1). This is due partly to chronic hypertrophy and infection of her tonsils partly to inability to masticate. Occlusion relates to one upper molar on each side all other teeth do not meet (Fig 2) the lower incisors project 1 centimeter in front of upper incisors, the chin is too low and too prominent. The deformity developed gradually beginning during the period of first dentition and continued until she was about 17 years of age. The arch of the upper jaw and roof of the mouth are within normal limits. The absence of other bony enlargements, the age of the patient, the time of onset etc. preclude the diagnosis of acromegaly.

The indications for surgical interference were threefold (1) to establish occlusion of lower with upper teeth so she could masticate food, (2)

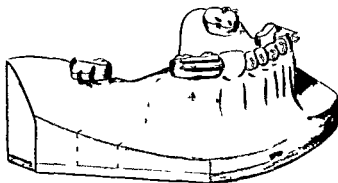


Fig 8 Cast with anchor bands as placed before operation

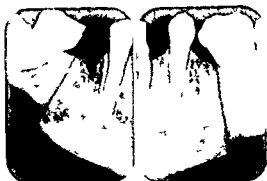


Fig 9 Roentgenogram showing condition after operation

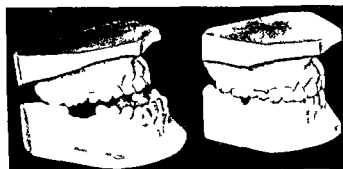


Fig 10 Casts showing occlusion before and after operation

to correct the deformity—a question of aesthetics, (3) and most important—to change the mental symptom complex.

Figure 3, a roentgenogram showing that the right lower second molar had been extracted just before the case came under my observation. The left lower first molar was pulpless, contained incomplete root canal fillings and showed rarefied areas around the apices, therefore I had that tooth extracted. I asked Dr Willett to retain both spaces. The lower third molars were in process of eruption. During this time of preparation her tonsils were removed.

I felt that neither Babcock's operation, consisting in severing the ramus horizontally above the mandibular foramen, nor the technique



Fig 11

Fig 11 Roentgenogram after operation showing good occlusion. The jaw had united on both sides and splendid masticatory function had resulted.



Fig 12

Fig 13

Figs 12 and 13 Roentgenograms 9 months after operation showing almost complete obliteration of line of resection of jaw.

employed by Harsha removing a rhomboid section from the body of the jaw between the last molar and the ramus would produce the best results in this case. In the former it was not advisable because an appreciable gap would be caused in the ramus by raising the resected segment to bring the anterior teeth into occlusion which in healing would tend to separate the anterior teeth during the period of contraction of the maturing tissue in the latter or the Harsha operation because there was not sufficient room between the last molar and the ramus to remove a rhomboid section of proper size. Nor did Gilmer's method seem adapted to produce an ideal result in this case since the lower molars containing vital pulps were in good position anteroposteriorly so far as occlusion with the upper ones was concerned. I decided therefore on an operation along the lines followed by Blair only instead of having normal bicuspids removed. I preferred to accept the handicap of a larger anterior fragment deprived of its principal nerve and blood supply for the sake of utilizing the space created by the extraction of the right lower second molar and ridding the patient of a questionable lower first molar. All

the remaining lower teeth contained vital pulps.

Patient came to city June 15 1925. I carefully studied the relation of the lower to the upper teeth and prepared two wedge shaped patterns one for each side marked R and L respectively since there were slight variations between the right and left sides. Figure 4 shows scientific manner of preparing patterns for correction of such deformities. These patterns were made 1 centimeter at widest end to correspond with the actual protrusion and at the time of operation I had them included with the instruments for sterilization.

Operation was done June 16 1925 under aspic ether anæsthesia. A longitudinal incision was made in the shadowline of the jaw 2 inches long down to but not including the periosteum. The external maxillary artery was cut on the right side and both ends were tied. The tissues were stripped up from the jaw to a point half way between the lower border and the alveolar crest both on the buccal and lingual surfaces. The periosteum was divided at that level and all the soft tissues in the alveolar region peeled from the bone as recommended by Blair care being taken not to penetrate into the mouth cavity at any point (Fig 5). An assistant placed his finger in the mouth of the patient and into the space caused by the extraction of the molar thus guiding a small dull ended instrument which I introduced into the wound into the center of that space. With this aid I placed the copper plate pattern for this side in place and with a scalpel marked off the section to be removed. A crosscut fissure bur revolved by a dental engine made both cuts through the external plate with a chisel I connected the cuts at the lower border and pried out that section of bone bringing the inferior alveolar vessels and nerve into view. Passing a ligature under these structures I tied them out of the way (Fig 6). I repeated the same technique



Fig 14 Photographs taken 1 month after operation



Figs 15 and 16 Scars on right and left sides resulting from suppurating wounds



Fig 18 Photograph after correction of scars

on the left side. However, I dissected out the external maxillary artery on this side, and tied and cut it between ligatures. I then removed the remaining portion of the section of the left side with rongeurs and bone cutting forceps after drilling a hole through each segment near the lower border for the purpose of immobilization. In removing this portion of the bone, I inadvertently cut the vessels and nerve, so I excised all of the exposed portion (Fig 7). Instead of silver wire I used kangaroo tendon to hold the fragments in apposition, securing the ends in a hæmostat after adjusting the first loop of a surgeon's knot. Next I finished the other side in the same manner except that I did not cut the vessels and nerve, but instead cut a groove in each fragment and looped the nerve and vessels on the buccal surface of the bone. The anterior fragment was now brought back and up so that the teeth occluded, and Dr Willett locked the teeth in position with a bar fastened to bands he had previously cemented to the teeth (Fig 8). Finally the kangaroo tendons were tied and the wounds closed. The cut ends lined up perfectly, although the lower border of the jaw did not but no attention was paid to that for good occlusion was paramount as shown in Figure 9. Figure 10 shows occlusion before and after operation.

Postoperative treatment consisted in wiring the lower teeth in occlusion with the upper ones after all danger of nausea from ether had passed,

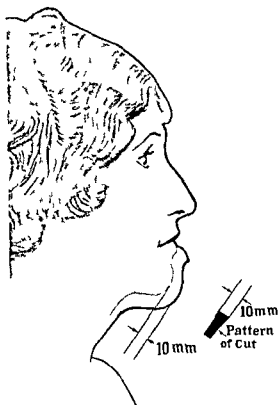


Fig 17 Recent photograph of patient with pantographic drawing superimposed

the application of cold to the wound for the first 24 hours followed by boric acid fomentations and irrigation of mouth with hot boric acid solution. There was no elevation of temperature, no swelling, no pain.

On the fifth day I removed the stitches to prevent scar formation. On the eighth day the left side became painful, swollen, and the wound opened discharging pus. On the ninth day the right side did the same. Discharge stopped on right side in two days and wound healed. The left side kept discharging for a month when the kangaroo tendon came away and it closed, a month later two small sequestra were cast off and the patient went home. The jaw united on both sides, with splendid masticatory function, because the teeth were placed and held in good occlusion as shown in Figure 11. Figures 12 and 13, roentgenograms made 9½ months after operation, show an almost complete obliteration of the line of resection by new bone. Tonus and feeling returned in the lower lip during the first week, the side where nerve and vessels were cut being more advanced in its return to normal than the other. Figure 14 shows correction of deformity 1 month after operation and Figures 15 and 16 show scars on right and left side resulting from suppurating wounds. Figure 17 is a photographic profile view

as it is now upon which a pantographic drawing was superimposed. The photographic view as it was before operation was used in order to outline the correction in the most accurate manner. It shows an exact reduction of the chin of 10 millimeters corresponding to upper width of patterns used in the operation.

Five months later the patient returned and I removed both scars closing the wounds with Halsted's subcuticular suture. Recovery was uneventful (Fig. 18). A comparison of Figures 1 and 14 will show what has been accomplished for her.

The result obtained was made possible only by close co-operation with Dr. Willett, the orthodontist who cared for the immobilization of the fragments etc. after the patient went home. Indeed, I feel that with such splendid co-operation all other fixation methods contemplating the lashing together of the bone fragments by means of kangaroo tendon, silver wire etc. passed through previously drilled holes may well be dispensed with, provided always that the patient has a sufficient number of firm teeth on which the appliance may be cemented.

The three indications for surgical interference have been met: (1) firm union, perfect articulation and splendid masticatory function were obtained; (2) the deformity was entirely corrected; (3) the desired mental change resulted, for whereas the patient prior to our treatment was a mental liability, she now appears as a mental asset—a comfort to herself and to her friends.

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## A METHOD OF TREATMENT OF OLD INFECTED COMPOUND FRACTURES OF THE TIBIA

By LAWSON THORNTON, M D, ATLANTA, GEORGIA

COMPOUND fractures often become infected, even under the most favorable antiseptic and aseptic care. The infection may subside or persist as a chronic suppurating bone sinus. Union of the fracture may occur but often the ends of the fragments become bound together by dense scar tissue. Bacterial invasion of the bone is usually limited to an area adjacent to the fracture. Compound fractures most frequently occur in the tibia. In our experience with old compound infected fractures of this bone, a plan of treatment has been evolved which has given uniform results. None of the procedures employed is original.

The infection is first cleared up and the wound allowed to heal. This is accomplished by a sculptural operation very similar to that employed in our treatment of chronic osteomyelitis. After the wound has healed, a brace is worn during that period of time when latent infection may be present. When this danger has passed a massive inlay bone graft is made to bridge the bony defect at the site of fracture, and the brace is again worn until union has occurred and the strength of the bone assured.

Before attempting a sculptural operation for clearing up the infection, an accurate conception of the location and extent of the diseased bone

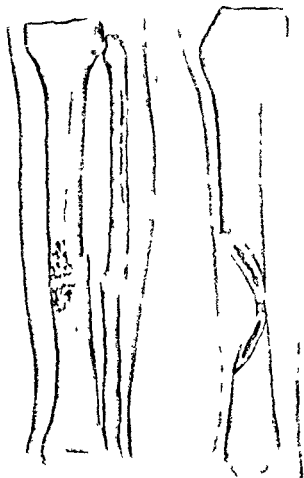


Fig 1

Fig 2

Fig 1 Showing compound infected fracture with fibrous union

Fig 2 The sculptural operation completed. The diseased bone has been carved away, leaving the long sloping surfaces to heal by granulation

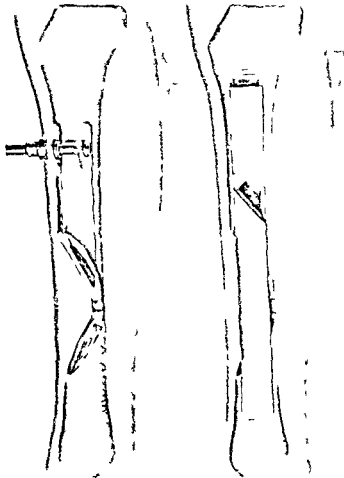


Fig 3

Fig 4

Fig 3 After the disease has been cleared up and wound has been completely healed for a sufficient period of time to justify the step as regards latent infection a massive inlay bone graft is placed to bridge the bone defect

Fig 4 The inlay bone graft





Fig 5 Roentgenogram of a typical old infected compound fracture with sequestra and infected bone sinuses

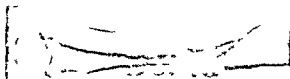


Fig 6 Roentgenogram of same tibia as shown in Figure 5 some time after sculptural operation had been done and after wound had healed by granulation



Fig 7 Roentgenogram of same tibia as in Figures 5 and 6 showing inlay bone graft. The tibia is united with firm bony union

and bone sinuses should be obtained by careful roentgenographic study. The bone is freely exposed subperiosteally over the anterior cortex and is so carved with a sharp chisel that all diseased bone is removed and all deep recesses obliterated. This usually leaves the exposed bone a shallow depression with long sloping surfaces much as if two chisels were placed with their cutting edges together. These sharp edges may be continuous bone or may be held together by dense fibrous tissue. When the operation is completed the wound is packed with gauze and a plaster cast is applied to the extremity extending from the upper thigh to the toes. On the fifth day the wound is dressed through a window in the cast. Thereafter daily dressings are made which consist in cleansing the surrounding skin and gently packing the wound with vaseline gauze. The wound is allowed to heal by granulation.

When healing of the wound is complete a leather steel brace is applied which is attached to the shoe and has motion at ankle and knee. The patient is gotten up with crutches and dismissed from the hospital.

After sufficient time has elapsed during which latent infection might be encountered a massive inlay bone graft is placed to bridge the bone defect. This period of time varies according to the individual case. Three to twelve months are usually required and the longer the delay the less danger there is of latent infection. A very large broad graft is most desirable because it must eventually bear much of the weight of the body. If for any reason a graft of sufficient size cannot be obtained from the fractured tibia it should be taken from the opposite leg.

In those cases in which a fracture of the fibula has also occurred it is usually found to be united with malposition. It may be necessary to correct the alignment of this bone but unless it causes deformity our plan has been to disregard it.

After the bone graft operation the extremity is immobilized in a plaster cast for 8 weeks and then the brace is reapplied and worn until the roentgenogram shows that the graft has assumed the structure and density of normal bone.

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# THE TECHNIQUE OF CAUTERY AMPUTATION OF THE CERVIX

By H P KUHN M D, F A C S KANSAS CITY, MISSOURI

From the Surgical Service of St. Luke's Hospital, Kansas City, Missouri

THE easiest and most efficient method of removing the cervix uteri, in the presence of suspected malignancy, is by the actual cautery. With a Downes' cautery blade, curved slightly, just at red heat, a complete amputation of the cervix at the level of the internal os can be done in 15 minutes with no hemorrhage and no shock. The resulting specimen is the cervix *in toto* which lends itself to thorough microscopic examination.

In the early stages of malignancy, a cure can be effected in a certain percentage of cases by this simple procedure. If the malignancy has extended beyond the level of the cautery, no harm has been done because no living cancer cells have been transplanted.

The technique is exceedingly simple. The only instruments are a heat controlled cautery knife, a weighted speculum, and two ordinary right angled retractors. Water cooled specula are not necessary. The procedure can be easily carried out under anesthesia induced with gas oxygen, and there is no pain whatsoever following the operation.

The patient should remain in bed a week or until the small eschar has separated. There has been no hemorrhage in any of our cases either at the time of operation or during the period of healing.

## INDICATIONS

The operation is indicated when the woman is past the climacteric, when malignancy is suspected, when the cervix is badly eroded, and when epitheliomata of the cervix, both in the early and the fairly well advanced stages are present. The procedure should not be carried out before the climacteric unless a supravaginal hysterectomy is to follow, because the cicatrization invariably closes the uterine canal.

## TECHNIQUE

After the ordinary preparation of the perineum the cervix is grasped with five pronged vulsella forceps. We have found Outland's vulsella excellent. Sharp traction is made and with the cautery at the proper heat (dull red) and controlled by a nurse at the operator's left elbow, the line of cauterization is carried along the junction of the vesical fold, coming upward toward the canal. This line of cauterization is carried completely around the cervix, at least 15 minutes being required for its completion. The resulting specimen is not unlike an acorn in contour. The vagina and cervix are packed loosely with gauze saturated with bipp paste. Healing takes place rapidly and outside of rest in bed and occasional douches, nothing further is to be done.

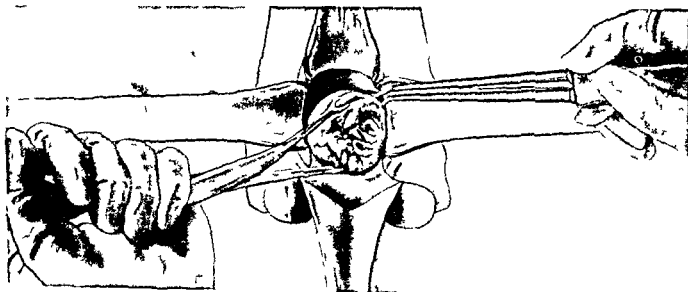


Fig. 1. Showing method of grasping cervix with large non-crushing vulsellum (Outland's) and arrangement of retractors. It will be noted that insulated or water cooled retractors are not necessary as the heat is in the knife.



Fig. 2 Showing the depth of amputation to the internal os. Note the cone shaped extraction.



Fig. 3 The Downes cautery knife used with the rheostat. Very careful control of the heat is important as only sufficient heat is used to cauterize. Too much heat will allow hemorrhage.

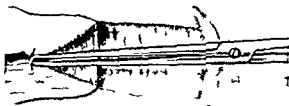


Fig. 4 Method of application of vulsellum forceps to get traction for observation of amputated stump.



Fig. 5

Fig. 5 Typical specimen. It should take about 10 to 15 minutes to remove the average cervix and there should be no hemorrhage on completion.

Fig. 6 Typical specimen of suspected malignancy.

In a few cases we have used the radium bomb which is made of non vulcanized rubber or patch

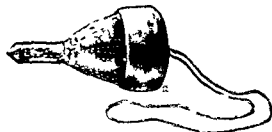


Fig. 7 Radium bomb showing radial placement of radium needles with one needle pointing into the uterine canal.

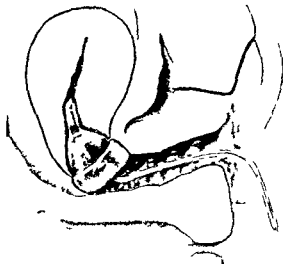


Fig. 8 The radium is inserted either in the matrix or as needles into the body of the uterus. One radium needle must be placed in the cervical canal.

ing rubber which has incorporated in it the necessary amount of radium. This bomb can be used immediately following the amputation or at the end of 2 weeks. We do not believe that this method of radium application is necessarily any more satisfactory than the usual method of placing radium needles, but it certainly gives excellent radiation.

## TRAUMATIC SYMPHYSIOTOMY

BY R. J. WILLAN, M.V.O., O.B.T., F.R.C.S. (ENG.), NEWCASTLE UPON TYNE, ENGLAND

Honorary Surgeon and Lecturer in Surgery to the Royal Victoria Infirmary

**T**RAUMATIC separation at the symphysis pubis, without a concomitant fracture of the pelvic ring posteriorly, is a rare occurrence. Ordinarily, little can be done in the way of treatment of a fractured pelvis, when the pelvic ring is fractured both anteriorly and posteriorly. For the bulk of fractures of the pelvis, the method I now describe would certainly not be suitable.

I have seen only two cases of traumatic pubic separation, and these came under my care within a year of one another. I had long ago thought out how such a case should be treated and these thoughts were successfully translated into practical use when the occasion arose.

The apparatus (Fig. 1) was devised to approximate, and keep approximated, the separated pubic bones. It consists of two concave steel plates, A, A', joined together anteriorly by a steel spring, B, B, B, so as to form a clamp. The strength of the pressure from the clamp is regulated by a threaded bolt and flanged screw nut, C. The steel plates are heavily padded with thick felt, A<sup>1</sup> A<sup>1</sup>, and are fitted to the patient into the space between the crest of the ilium and the upper margin of the femoral great trochanter.

The clamp was worn as tightly as the patient could bear it for the first few days, after that the tight clamping was not so necessary. Radiograms were taken at intervals and note taken of the size of the gap between the two pubic bones. Figure 2 is a photograph of Case 2, wearing the clamp.

It is difficult to gauge when a torn interpubic ligament unites. The period I had in mind was

about 8 weeks. In Case 1 the period observed was 3 months while the clamp was discarded by the patient in Case 2 in 7 weeks. As the time observed in Case 2 was effective, it would appear that 2 months is an adequate time.

In Case 1 the skin was inclined to become sore from the continuous pressure of the clamp. To ease this pressure on the soft tissues between the iliac crest and the femoral trochanter a second clamp was occasionally applied during the course of each 24 hours at the level of the femoral trochanters; this enabled the clamp proper to be removed, when the skin could be rubbed with methylated spirit. In Case 2 there were no pressure symptoms whatever, notwithstanding the fact that the clamp was kept applied continuously until finally discarded.

**CASE 1.** Colonel J. F. R. aged 40 was admitted under my care to a Private Hospital on April 3, 1925.

Some two or three hours previously, while hunting he was thrown from his horse when his outstretched hands and feet reached the ground simultaneously, his knees being fully extended at the time. His horse then rolled on to him, its weight being applied to the patient's sacral area when he was in this stooping position. Being a powerfully built man of 15 stones his lower extremities with extended knee joints were able to sustain temporarily at any rate the weight of the horse. But he experienced very acute pain in the pubic area, also in each groin, particularly in the left side. He was forced to the ground and found himself unable to stand up on account of the acute pain. He was removed to hospital in an ambulance.

When I saw him first he was suffering from severe shock. He was exquisitely tender when the pubic region was palpated; acute pain was felt in the same area on inward pressure being applied simultaneously to each side of his

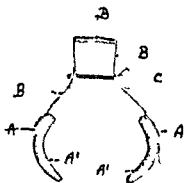


Fig. 1. Photograph of clamp.



Fig. 2. Photograph of patient with clamp applied.



Fig. 3 Roentgenogram of Case 2 showing wide separation of pubic bones

pelvis also when pressure was applied upward to the sole of each foot. There was no rigidity of the abdominal wall muscles and a rectal examination disclosed nothing abnormal. X-ray examination immediately after admission disclosed a separation of the pubic bones to the extent of about 1 inch.

As a temporary measure a strong webbing belt with three buckle was applied around the pelvis.

For the first 36 hours he vomited altered blood on several occasions. In the absence of muscle rigidity of the abdominal wall the view was taken that the vomiting was due to shock; this interpretation of a disturbing symptom proved to be correct.

For the first 4 days there was retention of urine requiring regular catheterization; normal micturition then became established and there was no further trouble. He had marked ecchymosis in each inguinal area which did not finally disappear for weeks. He also complained of a pricking pain in the left groin which persisted for months.

The clamp described was applied a few days after the accident and he wore it for 3 months. He was kept in bed for 11 weeks after which he began to get about on crutches but still wearing the clamp. The clamp was replaced by a thin leather pelvic girdle which he still wears.

The pubic area was examined at intervals by means of the X-ray which showed the continued approximation of the pubic bones. A recent radiogram now shows a normal symphysis pubis.

He resumed his full military duties 6 months after the accident.

His present condition can best be described by quoting an extract from a letter written to me by the patient under the date of September 2, 1926, i.e., 17 months after the accident.

I am glad to say I am getting on very well. I think I still go carefully and I daresay I could do a lot more than I do but every now and then I get a bit of a reminder which makes me slow up at once. I ride for an hour or two practically every day and have done now for the last 3 months. After 2 or 3 hours the pelvis begins to ache a bit but I suppose that is natural also if the horse shies or gets bobbly it hurts a bit but soon goes off. I sudden strain the inside of one leg but that improves.

One day I was playing squash racquets and the pain started badly. Anyhow it was not in the pelvis and I got



Fig. 4 Roentgenogram of Case 2 showing no gap in pubic bones

annoyed and went on with my game and let it hurt which it did considerably. Next day it was all right and I have not felt it since!

CASE 2. William R., aged 52, was admitted under my care to the Royal Victoria Infirmary, Newcastle upon Tyne, on March 24, 1926. On the previous day he was thrown from a horse. The horse half went down toward its off side; the patient tried to keep in the saddle when all the weight of his body (he weighs 13 stones) was taken by the left leg and thigh. He heard and felt a sharp crack; he had very acute pain at the symphysis pubis which caused him to faint. He thinks he fell on his right shoulder and he rolled clear of the horse. He attributes the accident to his trying to hold himself in the saddle.

After recovering from the faint he tried to pull himself into an upright position by holding on to a gate but the pain in the pubic area was so intense he had to desist. He found he could only stand if he was strongly supported on each side by two men and he subsequently walked some distance with such support.

On admission he was obviously in great pain. Lateral pelvic pressure caused acute pain in the pubic area; on palpation of the pubes the examining fingers entered deeply into the gap caused by the wide separation of the pubic bones. Defecation and micturition also; his urine were normal. X-rays showed wide separation of the pubic bones (Fig. 3).

The clamp was applied next day and was screwed tightly up. He immediately expressed great satisfaction at the comfort it gave him. As he suffered no discomfort from the pressure of the clamp this was not removed at all until it was finally discarded seven weeks after its first application.

Seen on September 29, 1926, he was walking normally and was carrying on his work as usual with the exception that he has not yet ridden a horse. He was not wearing any kind of pelvic support. Examination showed the pubic bones easily palpable with no gap between them. A roentgenogram (Fig. 4) taken at this date confirmed this.

I am indebted to the Radiological Department of the Royal Victoria Infirmary, Newcastle upon Tyne, for the radiograms.

# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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SEPTEMBER, 1927

### THE IMPORTANCE OF CLINICAL INVESTIGATION OF SYPHILIS

**E**VEN with all the refinements of the laboratory study of syphilis, the scrutinizing clinical investigation has not lost its importance any more than in the investigation of other diseases. It is surprising how often the physician fully conversant with the various manifestations of syphilis can find clues to the disease before laboratory study of any kind has been made. The pathognomonic signs are so rare in syphilis, however, that conclusions cannot be drawn unless the evidence is judiciously weighed. Since irregularity of the pupil does not necessarily indicate syphilis even when associated with periodic attacks of vomiting, nor every hyperkeratotic patch on the mucous membranes, syphilitic leucoplakia, such signs should set the full diagnostic mechanism, both clinical and laboratory, into motion.

There is considerable justification for the impression that the average physician, be he practitioner or specialist, does not make full use of clinical diagnostic methods. This seems to be more attributable to his mental

attitude than to lack of knowledge of syphilis. Possibly the unusual value of the Wassermann test as a laboratory aid has somewhat unbalanced his best judgment.

It is apparently necessary to reemphasize the importance of a suspicious attitude and the search for signs other than those presented for therapeutic consideration. This would of course include a painstaking elicitation of the history.

The suspicious mental attitude is justified by the fact that on conservative estimate, there are about ten million persons infected with syphilis in the United States alone. Considering the peculiar course of the disease and that so many persons are afflicted with it, it is clear that any physician should expect a reasonable proportion of it in his clientele. The specialist insists that unless the diagnostician is constantly on the alert for the disease it is often missed. This does not mean that the presenting complaint is always due to syphilis but, in a certain percentage of such cases, it is. Not uncommonly the syphilis in such a case is of more importance to the patient so far as his future welfare is concerned than the complaint for which he consults his physician.

It is then only fair to the patient that the physician in this suspicious attitude take a careful history and search for confirmatory signs. Careful examination is probably the most important and should be completed first, the physician will thus avoid being influenced too strongly by the patient's interpretation of his previous symptoms which in many cases is almost worthless. Not only will the easily visible areas bear inspection,

but the scalp neck axillæ penis (especially the meatus and glans) scrotum pelvis in guinal folds perineum anus the readily accessible mucous membranes and the palms and soles when exposed seriatim and subjected to a careful scrutiny will often disclose an unsuspected lesion. Scars may prove valuable diagnostic aids search for lymphatic and bony enlargements and vascular engorgements should be a part of the routine. Finally the rudiments of a neurological examination are indispensable the pupillary reflexes the biceps patellar and Achilles reflexes ankle clonus the Babinski and the Romberg signs and the simpler tests for sensory disturbance. It is surprising how often evidence in favor of syphilis is disclosed by such a search when casual inspection has not shown anything. If such an examination is followed by a painstaking investigation of the personal and family history the examiner will frequently be spared the chagrin of having another physician readily discover syphilis which he has overlooked.

W. H. GOECKLRMAN

### SURGERY OF THE SYMPATHETIC NERVOUS SYSTEM

THE terms sympathectomy sympathetic ganglionectomy ramisectomy and perivascular neurectomy are being seen in medical literature more frequently of late because of the renewed interest in surgical treatment of the sympathetic nervous system. Various surgeons have advocated cervical sympathectomy for exophthalmic goiter glaucoma, epilepsy, and so forth and the results have been more or less unsatisfactory aside from cervical sympathectomy for angina pectoris. Removal of the left superior cervical sympathetic ganglion has afforded complete relief from anginal pains in a few cases while in others it has been necessary to remove also

the middle and the inferior cervical ganglia yet complete cervical sympathectomy fails in most cases. A few patients have been relieved either completely or partially by the removal also of the right cervical chain.

The indifferent results are probably due to the various etiological factors producing the typical anginal attacks. In a few cases the anginal pain has a vasomotor basis and appears to be similar to the pain associated with the vasomotor disturbance in Raynaud's disease. This explains the relief afforded by excision of the left superior cervical ganglion since it gives off the accelerator nerves to the anterior cardiac plexus which also contains vasomotor fibers for the left coronary artery. The neurectomy relieves the vasomotor spasm of the coronary artery and the relief appears to be similar to that obtained from lumbar sympathetic ganglionectomy in Raynaud's disease of the lower extremities. Since anginal pain is usually due to arteriosclerosis of the coronaries and the arch of the aorta and to myocarditis or degeneration of the myocardium with or without coronary sclerosis relief would not be expected from superior cervical ganglionectomy since it is impossible to relieve intermittent claudication in the lower extremities when it is due to arteriosclerosis by lumbar sympathetic ganglionectomy. The reason patients suffering with angina pectoris from lesions of this type are occasionally relieved by removal of the stellate ganglion is no doubt that the surgeon has been able not only to remove the stellate ganglion but to interrupt the afferent sensory fibers from the heart. These sensory fibers are not constant in their course frequently they pass into the stellate ganglion at other times they pass through an intrathoracic sympathetic ganglion on to the upper dorsal roots. This intrathoracic sympathetic ganglion although communicating with the stellate is

often separated from the stellate and is situated just below it. Darnelopolu relieved a patient suffering from angina by injecting the upper six dorsal roots at the intravertebral foramen on the left side with a local anæsthetic. Similar results have been obtained from the injection of novocain followed by alcohol. However, it is difficult to differentiate the various etiological factors of true angina pectoris. There may be marked pathological change within the heart, and superimposed on this a mild vasomotor influence, or the reverse be true the pain may be due chiefly to the vasomotor disturbance in early arteriosclerosis or to mild myocarditis. It is obvious that anginal pains due to vasomotor spasm occur in middle age with little or no arteriosclerosis of the coronaries, and in such cases patients continue to live for years, without pain, after operation, nevertheless the course of the disease continues and the patient dies very soon as a result of the cardiac lesion.

Jonnesco and Leriche suggested pervascular sympathectomy and pervascular neurectomy for Raynaud's disease, for pain due to arteriosclerosis, for thrombo angustis obliterans, for scleroderma, for causalgia, and so forth. Since then, many other surgeons have employed similar procedures. Again the results have been more or less indeterminate. Occasionally, relief is afforded, but no definite assurance can be given the patient prior to operation. Failure is due chiefly to the improper selection of cases, and the limitation of the operation itself, which does not include enough of the nerves supplying the artery involved, the anatomical distribution of the vasomotor fibers of the vessels is segmental and they enter the sheath of the vessel at different levels rather than at the main trunk to follow the vessel to its final distribution.

It has been demonstrated that lumbar sympathetic ganglionectomy with ramisectomy relieves instantly and permanently the vasomotor spasm that occurs in Raynaud's disease. Such relief is more pronounced in the lower extremities than that from similar treatment of the upper, and is due to the fact that the Royle operation or complete cervical sympathectomy, fails to include all of the gray rami to the brachial plexus. It is true that lumbar sympathetic ganglionectomy and ramisectomy have failed to relieve patients suffering from pain and intermittent claudication due to arteriosclerosis, however, it has relieved the symptoms in a selected group of cases of thrombo angustis obliterans with superimposed vasomotor spasm of the collaterals of the principal arteries and veins.

Ramisectomy, as suggested by Royle and Hunter, diminishes plastic tone. This point has been argued extensively, pro and con. Kuntz has shown that plastic tone is diminished after division of the gray rami communicantes. The assertion made by Royle and Hunter that ramisectomy is indicated in a selected group of cases and that it will diminish spasticity, has been greatly misinterpreted and exaggerated. It will not alter cerebral degeneration or improve a mentally deficient child suffering from Little's disease, neither will it improve cerebellar ataxia, athetosis, or the tremor associated with Parkinson's disease. Clinically, it is indicated if spasticity has failed to respond or has responded only partially to the numerous orthopedic measures that are being employed.

Sympathectomy and ramisectomy are used experimentally in many cases, such as bronchial asthma, pyloric spasm, spasticity of the colon, and arthritis. As yet, no definite deductions can be made from the results.

A. W. ADSON, M.D.



# MASTER SURGEONS OF AMERICA

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## MAURICE HOWE RICHARDSON

**M**AURICE HOWE RICHARDSON was born at Athol Massachusetts December 31 1851. He came from a long line of New England farmers of English descent to whom this country is greatly indebted. He had his preliminary education in the public schools of Fitchburg, and later entered Harvard College from which he was graduated with the class of 1873.

Like many young men of that day he taught school immediately after leaving college and fortunately for him his first experience was in the high school at Salem Massachusetts where he became acquainted with Dr Edward B Peirson, a most estimable gentleman and physician of high standing in the community. This was important for Dr Richardson because he later married Dr Peirson's daughter a most admirable woman and because Dr Peirson undoubtedly had great influence in interesting him in the study of medicine and took him into his office for a year before he entered the Harvard Medical School. Dr Peirson was a fine type of general practitioner and the year spent with him gave Dr Richardson an excellent background for his professional work.

From Dr Peirson's office Dr Richardson entered the Harvard Medical School as a second year student and was graduated with the class of 1877. Soon after graduation he became a private assistant to the demonstrator of anatomy in that institution, the importance of which appointment evidently appealed to him since he gave up his duties as surgical house officer at the Massachusetts General Hospital in order to accept the position. For many years he was intimately connected with the anatomical department, his interest and enthusiasm in it were unbounded and he believed it was through this door that one should enter the practice of surgery rather than through the research laboratory as is customary at the present time. He was the first physician in New England to limit his practice entirely to surgery. While he had not the advantages of the European clinics like many of his time, he enjoyed the benefit of the traditions of those clinics as handed down through the elder Warren and Henry J Bigelow and through the close association of his colleagues, J Collins Warren and Arthur T Cabot who had been clinical students in Europe.

Dr Richardson was appointed to the staff of the Massachusetts General Hospital in 1881 and continued as an important and valuable member of that



MAURICE H. RICHARDSON  
1851-1912



body He also accepted the chair of clinical surgery at the Harvard Medical School in 1903, was made Moseley professor of surgery in 1907 and held both his hospital position and the professorship in the medical school until his death in 1912

As a teacher, Dr Richardson was a power in the class room Late in the afternoon, a group of eager students might be seen crowding about him to witness his demonstrations of surgical anatomy Interest was stimulated and the value of the anatomical demonstration impressed by the application of the anatomy demonstrated to some definite clinical problem An incident of these demonstrations which never ceased to interest the students was his ability to draw on the blackboard with both hands at the same time So contagious was his interest that the appointment of two students to perform the dissections necessary in the demonstrations caused enthusiastic and good natured rivalry among the members of the class His characteristic good judgment in the selection of these students is demonstrated by the fact that many of them have become well known surgeons in various part of the country He frequently came into the lecture room directly from his work, bringing the enthusiasm and exhilaration which always characterized him in the operating room This natural transition gave the students a sense of the intimate relationship between the subject of his lecture and the practice of surgery His varied experience and ready memory invariably offered him a fund of illustrations from which to draw one appropriate to the case in hand

At the hospital Dr Richardson's popularity and influence were even greater than in the school Here he came into intimate contact with house officers and junior members of the staff, who felt the magnetism of his enthusiastic and friendly personality One of the prominent characteristics of Dr Richardson was his frankness in discussing his errors in diagnosis, technique, and judgment, an example which stimulated not only his assistants but also surgeons throughout the country toward the attainment of professional sincerity and frankness

In addition to a large private practice and heavy hospital service, Dr Richardson found time to write on a great variety of subjects His earlier papers covered a wide field of general surgical problems, but later were confined largely to abdominal conditions Many papers showed the influence of his great friend and admirer, Dr Reginald H Fitz, with whom he worked in close association both in his private work and in the hospital There was always the rivalry which is present between medical and surgical men, but a most pleasant and stimulating one To his monographs, written in earlier years, he added a book on surgery of the abdomen, which he never completed Much of this volume was written between the hours of 5 and 8 in the morning, before his routine duties began

Dr Richardson's first work on the operative treatment of appendicitis was published in 1888 A piece of original work, based entirely upon his anatomical

knowledge, was the removal of a set of false teeth from the lower end of the œsophagus through the stomach. He published this paper in 1886. Three years later he performed the first successful cholecystostomy in New England. In 1898 he published his first case of total gastrectomy.

As an operator Dr. Richardson had few equals. Although of very strong physique and unusually large proportions, his delicacy of touch was marvelous and he was a master technician. He was noted as a skillful and rapid operator with great regard for tissue. While many of us feel that Crile has taught us much about the careful handling of tissue, Dr. Richardson may be called a pioneer in this art. It is interesting to note that Dr. Richardson's delicacy of touch was so rare that he was able to write the Lord's Prayer on a ten cent piece.

When we consider that the surgeons of his day were pioneers in modern surgery, we can but marvel at their skill and foresight. For in spite of the thousands of articles written on supposed improvements in technique, their work still remains as the foundation of it all. A friend once asked me what original work Dr. Richardson had done. Most of us forget that the surgeons of his time were constantly doing original work. They had to build up the foundations of the present day surgery, and I believe we all agree that they built wisely. Dr. Richardson was one of the men of the generation bridging the period between the pre antiseptic surgery and antiseptic and aseptic surgery, a period when every part of the body was thrown open to the surgeon by the employment of asepsis. This was a period when nearly every surgeon was obliged to employ his own methods and there was little standardization, as new technique for various operations was constantly being reported. It is a great tribute to the master surgeons of that period that their technique has stood the test of time, and while minor changes have been made in various procedures, the great bulk of them stand today as firm foundations of the present day surgery.

While Dr. Richardson was best known as a skillful operator, those who were close to him knew him as a brilliant diagnostician. While seemingly careless at times about the diagnosis, he always obtained by accurate observation, by remarkable ability to select the essential facts in a history, and by a highly developed sense of touch, sufficient information to enable him to make an accurate diagnosis. When one considers the modern elaborate methods of diagnosis, we who saw the brilliant results of Dr. Richardson and his contemporaries obtained by accurate observation, a careful history, and well trained fingers, are inclined to believe that our present methods are hardly commensurate with the effort expended. His judgment and sense of proportion were unusual.

As a man Dr. Richardson had all the qualifications of a surgeon, great strength and vigor, yet with the delicacy of touch of a musician, which he was, and a personality which left little to be desired. He had a remarkable power of observation and a well trained mind, was sympathetic, enthusiastic with an

enthusiasm which was contagious, simple, frank, never assertive or bigoted, his whole being expressed that simplicity and frankness which endeared him to friends, patients, and colleagues. It was his honesty of purpose and frankness in his writings and discussions which made a great impression upon students, medical men with whom he came in contact, colleagues, and surgeons everywhere.

Dr. Richardson was a musician of no mean ability, and early in his career played the piano and cello. His love for the woods and the streams was that of the boy who had been brought up in the country and knew every trout brook for miles about.

Dr. Richardson lived in the time when the surgeons of Boston did much of their work in the homes of patients and in the smaller hospitals scattered over New England. To carry on a large practice in this way is expensive in time and strength, and although with the latter he was exceptionally well endowed, he was generously and wholeheartedly unsparing of himself and his time. No patient was ever turned away because he or she could not afford to pay him. This type of work deprived Dr. Richardson to a very considerable extent, in the later years of his life, of the recreation which he found in music and out of door life.

We have then in Dr. Richardson all the qualities which go to make a master surgeon, one whose traditions are worthy to be handed down to the oncoming generations. He was a great teacher, not only because he was able to convey accurate knowledge and enthusiasm to the student, but because he had the ability to train younger men to carry on his work. He was a diagnostician of unusual ability and an operator of great skill. As a man he had the personality, the honesty of purpose, the simplicity, and frankness which had a great influence upon students and the profession in general.

D. F. JONES

# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

By ALFRED BROWN M.D. F.A.C.S. OMAHA

### THE SEVENTEEN BOOKS OF ORIBASIOS OF SAPDIS

FOUR names stand out above all others as representing the best there was in the medicine and surgery of the Byzantine period. Oribasios of the fourth century A.D. Alexander of Tralles and Aetius of Amida of the sixth century and Paul of Aegina of the seventh century. Oribasios of Sardis or Pergamus was the earliest of the group. He was born in 325 A.D. in Pergamus a city of Mysia situated on the shore of the Aegean Sea and noted as the birthplace of his great medical predecessor Claudius Galen one of the greatest physicians of all time. He obtained a good early education at home but not being content with what he could obtain in Pergamus went to Alexandria and there studied under the learned Zeno of Cyprus. As Oribasios was of noble birth and also gained considerable reputation as a brilliant student he came under the notice of Julian whom he met after he had completed his education at Alexandria and had gone to Athens. Being rather prominent and somewhat powerful politically he helped Julian the Apostate to gain the throne of the Caesars and in return was appointed Quaestor of Constantinople. Julian's reign was short lasting only from 361 to 363 but during this time Oribasios did most of his writing. At Julian's request he wrote a compendium of the works of Galen which has been lost. He also wrote the *Collectanea Medicinalia* which consisted of 70 books. Of these 25 have been preserved but the volume here illustrated contains but 17.

Oribasios' prominence depending as it did upon the favor of the emperor was short lived. Julian planned and executed a campaign into Persia and Oribasios accompanied him as physician in ordinary thus receiving some experience in the surgery of war. Julian however was wounded and Oribasios was unable to cure him. After Julian's death the new authorities promptly as was the custom took away Oribasios' property and banished him among the barbarians probably the Goths. He rapidly attained a great reputation as a physician and evidently became so prominent that his own country desired his return for shortly afterward he was brought back to Constantinople where he lived until his death in 493 A.D.

Though after his return to Byzantium Oribasios wrote a few small treatises both for the medical and lay public, his greatest work was the *Ιατρικὴ Συγγραφή* or Medical Collection. It was written in Greek but shortly after it was printed in the original Latin became the language of medicine and it was naturally translated into that tongue. The volume illustrated here prints 17 of the original 70 books which the translator John Baptist Rastarus states are all that are extant. The books are not in order for those from the fifteenth to the twenty fourth are missing and the volume includes the twenty fourth and twenty fifth books. As the title page shows it was printed in Paris by Bernard Turnebus at the Aldine press and bears the famous Aldine anchor and dolphin.

Oribasios was a compiler and follower of his predecessors in medicine and does not pretend to be anything else. He had evidently read carefully the works of these older men and his object in writing the treatise was to explain their ideas in simple terms. In every instance he gives credit to his authority and his list is too long to mention here but his constant reference to Galen, Antyllus and Rufus of Ephesus are worthy of mention. The books or chapters most interesting to the surgeon are the sixth, seventh, twenty fourth and twenty fifth. The sixth is devoted to hygiene and physical therapy including exercise and massage. In the seventh blood letting is discussed and the ideas of Antyllus and Galen as to the indications and sites for venesection are carefully gone into. Antyllus' operation for aneurysm is described. The twenty fourth and twenty fifth books are devoted to anatomy the twenty fourth to the anatomy of Galen and the twenty fifth to that of Rufus of Ephesus.

Throughout his works Oribasios seems to be approaching his subject with a judicial and unbiased mind. He is endeavoring to give the ideas of the authorities as best he may and letting his reader form his own conclusions rather than forcing his personal opinions on him. Consequently one feels that in this work he is getting a true insight into the thoughts and opinions of the ancient surgeons through the medium of an educated and clear thinking man and it is not difficult to understand why it was so frequently included in the Beneventan manuscript.

ORIBASII SAR-  
DIANI COLLECTO-  
rum Medicinalium,

LIBRI XVII,

QVI EX MAGNO SEPTVAGINTA  
librorum volumine ad nostram aetatem soli peruenierunt.

Ioanne Baptista Rasario, medico, Noua-  
riensi, interprete.



PARISIIS

Apud Bernardinum Turrisanum, via Jacobea, sub  
officina Aldina

1555





## REVIEWS OF NEW BOOKS

THE official history of the A E F neuropsychiatric organization is still in preparation. Dr Fenton<sup>1</sup> presents a book which for all practical purposes gives a thorough and most interesting account of the system of handling the neuroses which was developed in our army and a detailed account of the work of Base Hospital 117. Due credit is given to the vision and ability of Dr Thomas W Salmon who developed this organization. Thanks to the foresight and efficiency of the author, data were preserved which made possible further post war studies of the former patients of Base 117. The National Committee for Mental Hygiene sponsored two follow up studies, one in 1919-20 and another in 1924-25. The present volume offers the results of these intensive statistical studies, preceded by a thorough survey of the original material and followed by an outline of the problem of the neuroses with suggestions as to wiser methods of handling these cases in the future.

The volume is replete with tables but nevertheless makes easy reading. Though a short book, it represents a monumental amount of work done. All conclusions are weighed most carefully. It is possible here to give but a few examples. Among the patients was a significantly greater proportion of officers than men as compared to the normal ratio for troops, there were more volunteers admitted than conscripts, the infantry, which had the highest percentage of killed in action were not the highest among the psychoneurotics, there was a low proportion of patients who had come from agricultural pursuits, concussion, gas and anxiety types, the true war neuroses, did better in readaptation than the more constitutional types neurasthenia, hysteria or psychasthenia, the clerical and professional groups are making the best readjustments.

The title *Shell Shock* is somewhat surprising both because the author has no such limited conception of the problem as this might imply and in view of the statement on page 80 "the term *shell shock* was ruled out as an official diagnosis early in the history of the A E F".

According to Salmon, the World War was the first in which the functional nervous diseases constituted a major medicomilitary problem. The present volume is a fundamental contribution to military medicine and its subsequent responsibilities.

JOHN FAVILL

MONTAGUE'S book on hemorrhoids<sup>2</sup> is a good book for the general practitioner who does occasional hemorrhoid operations. The procedures of operation, the preliminary treatment, and the

after treatment which the author advocates are good, sane, common sense methods. These procedures are described in sufficient detail to make them understandable. RALPH BOERNE BRITMAN

A VOLUME<sup>3</sup> of 126 pages on applied refraction divided into 24 chapters with an index and several illustrations of recent equipment, contains the attributes and defects peculiar to all books detailing an author's personal views on any subject.

It is not for the beginner and details nothing of the science of refraction, but in it the author attempts an exposition of the art. It is his purpose not to consider controversial matters. Where doubt or differences exist the author gives his own opinion, hence, few references are given and few authorities quoted. The first chapters are devoted to a description of the refraction room, equipment such as chair, trial frame, case, test chart, ophthalmometer, cross cylinder and illumination. Much of this is good, especially the quiet surroundings and equanimity of patient and doctor, but ophthalmic paraphernalia housed in a bird cage perched on a pole, accoutered and buttressed with sliding doors, dials, discs, and control knobs, will never appeal to the more conservative. The old fashioned test chart is not to be discarded so easily nor replaced in the affections of the old artist who for years has worked out to a nicely many difficult cases with the less complicated but not so all inclusive an instrument as the genophthalmic visual test apparatus. It is true, perhaps that vision should be recorded in decimal fractions, instead of the old system wherein the numerator represents the distance of the patient from the test chart, to comply with the modern method of recording in all scientific work.

The author is in favor of cycloplegia in all cases and at all ages. The fear of glaucoma and the feeling that accommodation is being physiologically abolished, lead many to refrain from the use of a cycloplegic after middle life when the suppression of that accommodation, at the time of refraction, which does remain may very well be and often is the key to the solution of some symptoms of ametropia. The teachings of Duane and Jackson are monumental in this too often disputed field. Nor is the fact that the cycloplegic and post cycloplegic tests differ occasionally an argument against the dilatation of the pupil, with the greater facility of fundus study, temporary arrest of accommodation with the further therapeutic measure of retinal and choroidal decongestion. The very foundation of good refraction is cycloplegia. The author's treatment of cycloplegic and post cycloplegic refraction is altogether too complicated and too time consuming. The chapter on the non cycloplegic refraction is a contradiction of

<sup>1</sup> *SHELL SHOCK AND ITS AFTERMATH* By Norman Fenton Ph D St Louis Th Co Mosby Co 1926

<sup>2</sup> *THE MODERN TREATMENT OF HEMORRHOIDS* By Joseph Franklin Montague M D FACS Foreword by Harlow Brooks M D FACS Philadelphia J B Lippincott Co 1926

<sup>3</sup> *APPLIED REFRACTION* By Homer Erastus Smith M D New York William Wood and Company 1927

all the good attained by his arguments for a cycloplegia.

The anomalies of accommodation found at the post cycloplegic test are well described by the author in the eighteenth chapter but his classification and exposition of the relationship of them to visual acuity refractive error muscle imbalance position of work and convergence power is inconsistent. Here as in all else in refractive work the paramount issue is the individuality of the patient. In the same manner the author's treatment of the changes of refraction during advancing years cannot be so mathematically mapped out. The first cycle of 24 years concerns itself with growth and development with attendant changes in refraction. The second 24 years cannot be called one of stasis just because changes are not so marked as in the first and last quarter century of an ordinary life. Nor is it possible to expect eyes in the third quarter to manifest evidences of refractive change so uniform and consistent as to be prophesied and charted with such assurance as the author details. Very few eyes conform to type. While the changes through the years may be great or small spherical or astigmatic the changes are there and they need ever constant correction if eyes are to remain healthy and retain perfect functioning power.

The closing chapters are concerned with the mechanics of lenses their manufacture and adjustment for use in spectacles and a chapter is devoted to prisms and the correction of muscular anomalies.

VIRGIL WESCOTT

**DOCTOR LENKS** splendid work on X ray therapy<sup>1</sup> has proven so popular that it has gone through several editions and has been translated into five languages. This is abundant evidence of its value to the profession and a sufficient reason for this English translation. With a foreword by Holzknecht the book is in index form and the subject is presented not primarily to the specialist in X ray therapy but to the general practitioner although the roentgenologist too will find much practical help in the treatment formulæ which are given under each of the conditions described. The X ray dosages are given in terms of Holzknecht units and are entirely practical and easy to apply. The various lesions amenable to X ray radiation are arranged alphabetically and the great number of diseases specified in detail will be a surprise to many. This work is the result of an unusually large clinical experience at the University of Vienna and is a reliable guide to the practical application of X ray in the treatment of disease.

EDWARD S. BLAINE

**IN** the eighth edition of the *Manual of Bacteriology*<sup>2</sup> by Muir and Ritchie Professor Muir has had the assistance of Dr Carl H. Browning Gardner

INDEX AND HANDBOOK OF X RAY THERAPY. By Robert Leitch. 2nd ed. 1936. 112 pp. 10s. 6d. Oxford University Press.

MANUAL OF BACTERIOLOGY. By Robert Muir, M.A., M.D., and James Ritchie, M.A., M.D. 8th ed. 1937. 10s. 6d. Oxford University Press.

professor of bacteriology University of Glasgow and Dr Thomas J. Mackie successor to the late Dr James Ritchie as Irvine professor of bacteriology University of Edinburgh. This textbook being designed primarily for students and practitioners of medicine only the pathogenic bacteria protozoa and fungi are considered at any length. The method of presenting the subject is the same as in previous editions with but minor changes.

Since the seventh edition which was published in 1919 the science of bacteriology has been marked not so much by outstanding discoveries as by a steady growth in our knowledge and improvement in technique. The advances have been comprehensively incorporated in this latest edition by extensive additions and alterations. Portions shown by time to be less important have been condensed or put in smaller type with the result that the work is but slightly larger than the previous edition. The effort to maintain the size of the volume has led to the use of poor spacing too small type and crowded pages. This is a real objection for the student must intensively study a textbook which accordingly should be capable of being read with ease. The quality and extent of the contents of this book warrant a larger volume.

The older nomenclature of bacteria has been employed followed by that of the Society of American Bacteriologists. Both the older and the Society of American Bacteriologists' classification and nomenclature are described in the text. The bibliography has been brought up to date by chapters at the end of the book.

A. A. DAY

**THE** fourth edition of the standard French text book on local anaesthesia is just off the press.<sup>3</sup> The widespread surgical activities of Victor Pauchet furnish plenty of material for his associates to develop and practice methods of local anaesthesia. The material is handled in such a way that methods of anaesthesia are separated to a great extent from their regional application and from the description of typical operations. Repetitions are consequently unavoidable and the references from one place to another are not always accurate. The value of the book would be greatly enhanced if the results and the untoward symptoms of these methods were mentioned. Some of the statements in the book are open to discussion for instance that stavain is a marvelous drug in spinal anaesthesia the large amount of adrenalin to be added to the novocain solution and particularly the strong advocacy of paravertebral injections. The illustrations are diagrammatic but serve their purpose well. Their origin is not always stated although due credit is given to most of the recent French workers. The succession of editions proves the need of such a book which adds to the spread and development of new and reliable anaesthetic procedures in the French literature.

G. DE TAKATS, M.D.

ANESTHESIE R. GONVILLE. By Victor Pauchet, P. Sochat, G. Labat, R. de But, R. O. M. 2nd ed. 1937. 10s. 6d. Oxford University Press.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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## COMPLETE PROGRAM FOR THE CLINICAL CONGRESS IN DETROIT

PLANS for the seventeenth annual Clinical Congress of the American College of Surgeons, to be held in Detroit, October 3 to 7, 1927, are practically complete. Under the leadership of a strong and representative committee of Detroit and Ann Arbor surgeons, a program of clinics and demonstrations that will adequately represent the clinical activities in the hospitals of Detroit and Ann Arbor, the medical school of the State University at Ann Arbor, and the Detroit College of Medicine and Surgery, has been prepared and is published in the following pages. The program is to be further revised and amplified during the weeks preceding the Congress. Clinics and demonstrations will be conducted during the mornings and afternoons of each of the four days, Tuesday to Friday inclusive. Members of the faculty of the medical school of the State University are making special plans to entertain the visiting surgeons on each of the four days.

The actual program of the Congress is to be issued daily during the session, giving in complete detail a description of the clinics and demonstrations at the several hospitals and medical schools. This program will be issued in the form of bulletins posted each afternoon at headquarters for the following day's clinics. A printed program will be issued each morning. The clinical program for Tuesday will be posted during Monday

afternoon and reservations for tickets for Tuesday's clinics may be filed late that afternoon.

An important feature of the clinical program will be a special series of clinical demonstrations, illustrative of diagnosis and operative and post-operative treatment of surgical conditions to be held at Orchestra Hall in the afternoons and at the Statler Hotel in the mornings. The details will be found in the following pages.

On Friday afternoon in Orchestra Hall there will be a symposium on traumatic surgery. Much interest will center in this symposium as leaders of industry, labor, the indemnity companies, and the medical profession will here combine for consideration of a subject of mutual interest. These four groups have all a direct interest in the efficient care of the injured and means by which they may co-operate to improve the practice of traumatic surgery will be discussed by the leaders from all standpoints. Technical surgical details will not form a part of this program. A report will be presented by the Board on Traumatic Surgery on its activities of the present year, and also an outline of its program for the coming year.

General headquarters for the Congress will be established at the Book Cadillac and Statler Hotels, both located on Washington Boulevard. At the former hotel will be found the registration and ticket bureaus, bulletin boards, exhibits,

etc., while the large public rooms at the latter hotel will be utilized for clinical demonstrations and various scientific meetings.

There will be on exhibition at headquarters during the Congress a replica of the Lister exhibit in the Wellcome Historical Medical Museum in London which has been presented to the College by Mr. Henry S. Wellcome.

The annual meeting of the Fellows of the College for the election of officers and the reception of reports of officers and committees will be held in Orchestra Hall on Thursday afternoon at 2 o'clock.

#### EVENING MEETINGS

The Executive Committee has prepared programs for evening sessions on each of the five days of the Congress. These will be held in Orchestra Hall, a new and beautiful auditorium located on Woodward Avenue convenient to the hotels.

On Monday evening at the Presidential Meeting the first formal session of the Congress, the President Elect Dr. George David Stewart of New York, will be inaugurated and deliver the annual address. On the same evening Sir John Bland Sutton of London will deliver the John B. Murphy oration in surgery.

The meeting on Tuesday evening will take the form of a memorial to Lord Lister, this being the year of the Lister centennial. The principal speaker will be Dr. W. W. Keen of Philadelphia, the Nestor of American surgery, who was one of the first on this continent to use Lister's methods.

The annual convocation will be held on Friday evening on which occasion the 1927 class of candidates for fellowship in the College will be received.

#### ANNUAL HOSPITAL CONFERENCE

The tenth annual Hospital Standardization Conference of the American College of Surgeons opens on Monday, October 3, with morning and afternoon sessions in Orchestra Hall. During the following three days there will be morning and afternoon sessions at the Statler Hotel. A most interesting program of addresses, round table conferences and general discussions dealing with everyday problems of practical interest will be presented.

Special demonstrations in various phases of hospital administration will be given in the Detroit and Ann Arbor hospitals on Wednesday and Thursday afternoons. On Wednesday morning there will be a most interesting symposium on the standardization of special departments for eye, ear, nose and throat patients in the general hospital.

The program throughout will be of particular interest to surgeons and physicians, superintendents, trustees, nurses and hospital personnel generally, and a cordial invitation is extended to all persons interested in hospital work to attend.

An unusual opportunity is afforded hospital people this year to attend three national hospital meetings in succession beginning with the Hospital Conference of the American College of Surgeons at Detroit, October 3-6, leaving Detroit on October 6, spending October 7 visiting Chicago hospitals and arriving in Minneapolis the morning of October 8 to attend the American Protestant Hospital Association and the American Hospital Association meetings the week of October 10.

#### SPECIAL PROGRAM ON SURGERY OF THE EYE, EAR, NOSE AND THROAT

The subcommittee in charge of the section on surgery of the eye, ear, nose and throat has prepared a comprehensive and attractive program of clinics and demonstrations that will be of real interest to surgeons engaged in the practice of ophthalmology and otolaryngology.

The program includes a series of clinical demonstrations on Tuesday, Thursday and Friday forenoons with a special session on Wednesday forenoon devoted to a symposium dealing with the standardization of the eye, ear, nose and throat departments in general hospitals. All of these sessions will be held at the Statler Hotel.

At the Tuesday morning session papers comprising a symposium on brain abscess will be presented at the Thursday morning session a symposium on plastic surgery, and on Friday morning a symposium dealing with various aspects of the treatment of eye injuries in industry.

During the afternoons of each of the four days, Tuesday to Friday inclusive, the clinicians of Detroit and Ann Arbor will entertain the visiting surgeons at clinics in the several hospitals. A comprehensive and varied program of operative clinics and demonstrations has been prepared covering all phases of clinical work in these special fields.

#### REDUCED RAILWAY FARES—CERTIFICATE PLAN

The railways of the United States and Canada have authorized reduced fares on account of the Detroit session of the Clinical Congress, so that the total fare for the round trip will be one and one-half the ordinary first-class one-way fare. To take advantage of the reduced rates it is

necessary to pay the full one way fare to Detroit, procuring from the ticket agent when purchasing ticket, a "convention certificate" which certificate is to be deposited at headquarters for the use of a special agent of the railways. Upon presentation of vised certificate to the ticket agent in Detroit not later than October 11 a ticket for the return journey by the same route as traveled to Detroit may be purchased at one-half the regular one way fare.

In the eastern, central, and southern states and eastern provinces of Canada tickets may be purchased between September 29 and October 5, in southwestern and western states between September 28 and October 4, and in the far western states and western provinces of Canada between September 24 and 30. The return journey from Detroit must be begun not later than October 11.

The reduction in fares does not apply to Pullman fares, nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to rates, routes, etc. Stopovers on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Detroit, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and vised by a special railroad agent in Detroit during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Detroit and that the certificate must be presented during the meeting and return ticket purchased and used not later than October 11.

An exception to the above arrangement is to be noted in the case of persons traveling from points in the Pacific Coast states and British Columbia, who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30, with a final return limit of October 31. The summer excursion fare is considerably lower than the convention fare of one and one half fares for the round trip, but is available only in the Pacific Coast states and British Columbia. Tickets sold at summer excursion rates permit traveling to Detroit via one direct route and returning via another direct route, with liberal stop over privileges.

#### LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the Detroit session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. Therefore those who wish to attend must register in advance.

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets, which plan has proved an efficient means of providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic is limited to the capacity of the room assigned to that clinic.

#### REGISTRATION FEE

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters during the meeting. This card, which is nontransferable, must be presented to secure clinic tickets and admission to the evening meetings.

#### DETROIT HOTELS AND THEIR RATES

There are ample first class hotel accommodations in Detroit for all who wish to attend, most of the hotels being located within short walking distance of the headquarters hotels.

	MINIMUM RATES WITH BATH	
	Single Room	Double Room
Barlum, Cadillac Sq. at Bates	\$2.50	\$4.00
Book Cadillac Washington and Michigan	4.00	6.00
Carlton Plaza 2931 John R. St.	2.50	4.00
Clifford Clifford and Duffield	2.50	4.00
Detroit Leland Cass at Bagley	3.50	5.50
Fairbairn Columbia and John R.	5.00	4.00
Fort Shelby, Lafayette and First	3.00	4.50
Fort Wayne Cass and Temple	2.50	3.50
Gotham John R. and Orchestra Pl.	2.50	3.50
Imperial, 26 Peterboro St.	3.00	5.00
Madison Lenox, Madison Ave.	2.50	3.50
Norton Jefferson and Griswold	2.75	4.50
Palmetto John R. and Hancock	3.50	5.00
Royal Palms 2305 Park Ave.	3.50	5.00
Savoy Adelaide and Woodward	2.50	4.00
Statler, Grand Circus Park	3.00	5.00
Stevenson 46 Davenport	2.50	4.00
Strathmore 70 W. Alexandrine	2.00	3.50
Tuller, Grand Circus Park	2.50	5.00
Webster Hall, 111 Putnam Ave.	3.00	

## PROGRAM FOR EVENING MEETINGS

IN ORCHESTRA HALL AT 8 15 P M

*Presidential Meeting—Monday October 3*

Address of Welcome ALEXANDER W BLAIN M D Chairman of Committee on Arrangements  
 Address of Retiring President WALTER W CHIPMAN M D F R C S (Edin ) Montreal  
 Introduction of Foreign Guests  
 Inaugural Address GEORGE DAVID STEWART M D New York  
 The John B Murphy Oration in Surgery SIR JOHN BLAND SUTTON Bt LL D M D F R C S, London

*Lister Centenary—Tuesday October 4*

Presentation of the Replica of the Lister Exhibit in the Wellcome Historical Medical Museum, London  
 HENRY S WELLCOME Esq London  
 Presentation of the Lister Tablet to the American College of Surgeons HORACE G WETHERILL M D  
 Monterey California in behalf of the Western Surgical Association  
 Introduction of JOHN STEWART C B E M B C M LL D Halifax Nova Scotia who was an assistant  
 to Lord Lister  
 Lister Oration WILLIAM WILLIAMS KEEN M D Ph D LL D F R C S (Eng Edin Ire ) Philadelphia  
 Lister's Influence on Present Day Surgery WILLIAM J MAYO M D Rochester Minnesota  
 Remarks by SIR JOHN BLAND SUTTON Bt LL D M D F R C S London England

*Wednesday October 5*

HOWARD C TAYLOR M D New York Radical Operation for Cancer of the Uterus  
 PROFESSOR GUSTAF E ESSEN MÖLLER Lund Sweden One Thousand Laparotomies for Myoma Uteri  
 PROFESSOR S A GAMMELTOFT Copenhagen Denmark Heart and Pregnancy  
 JOHN OSBORN POLAK M D Brooklyn Fibroids in Pregnancy and Labor

*Thursday October 6*

FRANK H LAHEY M D Boston Surgery of Gastric and Duodenal Ulcers  
 ROBERT GORDON CRAIG M B Ch M Sydney Australia Hydatid Disease of the Kidney  
 GEORGE P MULLER M D Philadelphia Suppurative Diseases of the Chest

*Convocation—Friday October 7*

Conferring of Honorary Fellowships  
 Presentation of Candidates for Fellowship  
 Presidential Address GEORGE DAVID STEWART M D New York  
 Fellowship Address

## CLINICAL DEMONSTRATIONS IN SURGERY

*Tuesday 9 30 a m—Statler Hotel*

- DAVID H. BALLON, M D, C M, Montreal Diagnostic Value of Lipiodol in Bronchopulmonary and Pleural Lesions  
 SAMUEL IGLAUER, M D, Cincinnati The Advantages of Brominized Oil in Bronchography in Tuberculous Patients  
 HUBERT A. ROYSTER, M D, Raleigh, North Carolina Appendicitis

*2 30 p m—Orchestra Hall*

- GEORGE W. CRILE, M D, Cleveland Cases of Gall Bladder Disease  
 EUGENE H. POOL, M D, New York Lesions of the Large Intestine  
 HUGH H. YOUNG, M D, Baltimore Progress of Antisepsis in Urology

*Wednesday, 9 30 a m—Statler Hotel*

- ELMER HESS, M D, Erie, Pennsylvania Tuberculosis of the Kidney  
 LEONARD G. ROWNTREE, M D, Rochester, Minnesota Cardiovascular Complications  
 C. JEFF. MILLER, M D, New Orleans Management of Chronic Endocervicitis

*2 30 p m—Orchestra Hall*

- J. M. T. FINNEY, M D, Baltimore Speaking of Operations  
 ERNST A. SOMMER, M D, Portland, Oregon Treatment of Acute Traumatic Joints  
 JOHN B. DEEVER, M D, Philadelphia Ulcers of the Stomach

*Thursday 9 30 a m—Statler Hotel*

- LILIAN K. P. FARRAR, M D, New York Carcinoma of the Cervix and Application of Radium  
 BARTON COOKE HIRST, M D, Philadelphia Different Types of Cesarean Section  
 VILRAY P. BLAIR, M D, St. Louis Ankylosis of the Jaw, Correction of the External Appearance as Well as Ankylosis  
 ROBERT S. CATHCART, M D, Charleston, South Carolina Massive Sarcoma of the Breast

## CANCER SYMPOSIUM

*Thursday 3 00 p m—Orchestra Hall*

- Report of Progress and of Prospect ROBERT B. GREENOUGH, M D, Boston, Chairman of the Committee on the Treatment of Malignant Diseases with Radium and X Ray  
 The Lead Treatment of Cancer HENRY J. ULLMANN, M D, Santa Barbara, California  
 Report on the Results of High Voltage X Ray Treatment in Cancer WILLIAM A. EVANS, M D, Detroit  
 The Use of Radium in the Treatment of Uterine Pathology IRVIN ABELL, M D, Louisville  
 Histological Estimation of the Malignancy of Tumors A. COMPTON BRODERS, M D, Rochester, Minnesota  
 Analysis Report GEORGE A. SOPER, Ph D, New York, Managing Director American Society for the Control of Cancer



## SURGERY OF THE EYE, EAR, NOSE, THROAT AND MOUTH

*Tuesday 9 30 a m—Statler Hotel—Don M Campbell M D Chairman*

## Symposium Brain Abscess and Tumor

PROFESSOR DR G ALEXANDER Vienna Austria Choked Labyrinth and Its Importance in Diagnosis and Indication in Brain Tumor

JOSEPH C BECK M D Chicago Brain Abscess and Tumor from the Standpoint of the Otolologist and Rhinologist

ALFRED W ADSON M D Rochester Minnesota Brain Abscess and Tumor from the Standpoint of the Neurological Surgeon

W I LILLIF M D Rochester Minnesota Views of Importance of Eye Ground Examination and Fields of Vision

Discussion opened by J MILTON ROBB M D Detroit

*Wednesday 9 30 a m—Statler Hotel—George E Frothingham M D Chairman*

## Symposium Standardization of Special Departments for Eye Ear Nose and Throat Patients in General Hospitals See detailed program under Hospital Conference

*Thursday 9 30 a m—Statler Hotel—Burt R Shurly M D Chairman*

## Symposium Plastic Surgery of the Face

VILRAY P BLAIR M D St Louis Plastic Surgery of the Face

Discussion by WALTER R PARKER M D Detroit and FERRIS SMITH M D Grand Rapids

EDMUND B SPAETH M D Philadelphia The Use of Fascia and Cartilage in Ophthalmic Plastic Surgery

Discussion by HARRY GRADLE M D Chicago

JOHN M WHEELER M D New York Plastic Repair of Orbit and Eyelid

C D PARFITT M D Cravenhurst Ontario Tuberculosis of the Larynx

Discussion opened by GUY H McFALL M D Detroit

*Friday 9 30 a m—Statler Hotel—Walter R Parker M D Chairman*

## Symposium Industrial Eye Surgery

SIDNEY WALKER M D Chicago Aftermath of 250 Intra Ocular Steel Cases

F D GULLIVER M D New York

PLINN F MORSE M D Detroit

DON M CAMPBELL M D Detroit

## PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, UROLOGY, ORTHOPEDICS, ETC

## UNIVERSITY HOSPITAL

(Ann Arbor)

## Tuesday

- REUBEN PETERSON—10 Hysterectomy for fibroid operation for ovarian cyst  
 HUGH CABOT—10 Nephrectomy for tuberculosis suprapubic prostatectomy litholapaxy for stone in bladder  
 F A COLLIER—10 Subtotal thyroidectomy for exophthalmic goiter resection of stomach for cancer radical operation for cancer of breast  
 MAY PEET—10 Section of sensory root of gasserian ganglion, removal of cerebellar tumor removal of spinal cord tumor  
 CARL F BADGLEY—10 Ununited fracture of neck of femur extra articular fusion of hip for tuberculosis, Dunn's operation for calcaneus foot  
 CARL W EBERBACH—10 Subtotal thyroidectomy for adenomatous goiter nephrectomy for tuberculosis, pyelotomy for renal calculus  
 JOHN ALEXANDER—10 Extrapleural thoracoplasty for pulmonary tuberculosis phrenicectomy for pulmonary tuberculosis drainage of abscess of lung  
 VERNON HART—10 Ober's operation for club foot Hoke's operation for club foot arthrodesis of knee for tuberculosis  
 ALFRED S WARTHIN—10 Pathological conference  
 EDWARD CATHCART—1 30 Suprapubic drainage of bladder (first stage prostaticectomy) epididymectomy for tuberculosis endothermy for bladder tumor  
 P M HICKEY—1 30 Dry clinic Diagnosis of bone tumor  
 F A POILE—2 15 Dry clinic Use and abuse of ultra violet rays  
 C D CAMP—3 Dry clinic The role of the neuropsychiatrist in avoiding unnecessary operations

## Wednesday

- REUBEN PETERSON—10 Hysterectomy for pelvic inflammation abdominal sterilization  
 HUGH CABOT—10 Cholecystectomy with cholelithiasis cholecystoduodenostomy for biliary obstruction appendectomy  
 F A COLLIER—10 Subtotal thyroidectomy for toxic adenomatous goiter gastro enterostomy for duodenal ulcer operation for prolapse of rectum  
 MAY PEET—10 Chordotomy for intractable pain of cancer cerebral tumor section of sensory root of gasserian ganglion  
 CARL F BADGLEY—10 Transplantation of tensor fascia femoris for poliomyelitis open reduction of slipped femoral epiphysis, operation for ununited fracture  
 ALFRED S WARTHIN—10 Pathological conference  
 CARL W EBERBACH—10 Suprapubic prostatectomy urethrostomy for urinary incontinence ureterotomy for stone  
 JOHN ALEXANDER—10 Thoracoplasty for chronic empyema phrenicectomy for pulmonary tuberculosis  
 EDWARD CATHCART—10 Suprapubic prostatectomy orchepexy for undescended testis  
 A S WARTHIN—1 30 Dry clinic Pathology of goiter  
 G CARL HUBER—2 15 Dry clinic Development of kidney

VERNON HART—1 30 Arthrodesis of knee for tuberculosis tendon transplantation for poliomyelitis arthrodesis of shoulder for tuberculosis

## Thursday

- REUBEN PETERSON—10 Repair of relaxed vaginal outlet repair of complete perineal tear  
 HUGH CABOT—10 Appendectomy suprapubic prostatectomy nephrectomy for tumor ureterocolostomy for exstrophy  
 F A COLLIER—10 Cholecystectomy for cholecystitis colostomy for cancer of rectum subtotal thyroidectomy for adenomatous goiter  
 MAY PEET—10 Section of sensory root of gasserian ganglion operation for cerebellar tumor  
 CARL F BADGLEY—10 Synovectomy for chronic infectious arthritis, Hibbs operation for fusion of spine arthrodesis of hip for tuberculosis  
 CARL W EBERBACH—10 Subtotal thyroidectomy for toxic adenomatous goiter radical cure of chronic osteomyelitis pyelotomy for renal calculus  
 JOHN ALEXANDER—10 Extrapleural thoracoplasty for tuberculosis extrapleural pneumolysis  
 VERNON HART—10 Tendon transplantation for poliomyelitis arthrodesis of ankle for poliomyelitis transplantation of fibula for loss of substance in tibia  
 UDO J WILE—1 30 Dry clinic The pre operative treatment of syphilis in surgical cases  
 P M HICKEY—2 15 Dry clinic Graham's method of diagnosis of gall bladder lesions  
 L H NEWBURN and HUGH CABOT—3 Dry clinic Nephritis and renal infections  
 EDWARD CATHCART—1 30 Diverticulectomy for diverticulum of bladder excision of bladder tumor suprapubic prostatectomy

## HERMAN KIEFER HOSPITAL

## Tuesday

- EARL W MAY—9 Hyperplasia of thymus in newborn  
 E J O BRIEN and G C PENBERTHY—10 Thoracoplasty surgery of phrenic nerve operations and demonstration of cases  
 L REYNOLDS—10 X ray demonstration

## Wednesday

- RUSSEL ALLES—9 Blood transfusion  
 E J O BRIEN and G C PENBERTHY—10 Thoracoplasty surgery of phrenic nerve operations and demonstration of cases  
 L REYNOLDS—10 X ray demonstration

## Thursday

- C C BIRKLE—9 Demonstration Tuberculous enteritis  
 G C PENBERTHY—9 Empyema  
 W L SEELY and staff—9 Obstetrical ward walk

## Friday

- E J O BRIEN and G C PENBERTHY—9 Thoracoplasty surgery of phrenic nerve, operations and demonstration of cases  
 L REYNOLDS—9 X ray demonstration

## HARPER HOSPITAL

## Tuesday

- MAX BALLIN and associates—9 Surgical clinic  
 C W HALLIDAY and C G JENNINGS—9 Goutier clinic  
 Incidence of goiter medical aspects of goiter  
 GEORGE KAMPERMAN—9 Gynecological operations  
 WARD SEELEY—9 Demonstration Management of pelvic inflammatory disease  
 F H COLE—9 Demonstration Methods of diagnosis of ureteral obstruction  
 W K REXFORD—9 Demonstration Bladder tumors  
 R A MACARTHUR—9 Demonstration Treatment of epididymitis  
 H C SALTZSTEIN and TRIAN LEUCUTIA—9 Cancer clinic  
 A D LAFERTE—9 Open treatment of fractures  
 F C KIDNER—9 Cases of enchondromata  
 R V FUNSTON—9 Orthopedic results  
 HAROLD HENDERSON—9 Puerperal sepsis  
 O C FOSTER—9 Fetal mortality causes  
 C L STRAITH—9 Oral surgery clinic operations and demonstration of cases  
 J J TOLAN—9 Dental infections  
 F C VALE—9 Dry clinic Surgical and medical aspects of gastric and duodenal ulcer

## Wednesday

- C D BROOKS and associates—9 Surgical clinic  
 W A EVANS—9 Demonstration Roentgenology of the gallbladder  
 NORMAN ALLEN—9 Diagnosis of gastric malignancy  
 F C KIDNER—9 Orthopedic operations  
 L J HIRSCHMAN—9 Proctological operations  
 A C HALL—9 Demonstration Industrial surgery fractures of os calcis  
 E C DAVIDSON—9 Demonstration Treatment of burns  
 T F MULLIN—9 Demonstration Dislocation of semilunar cartilage and fractures of scaphoid  
 BYRON LONEY—9 Electrical burns  
 G B CARPENTER—9 Treatment of carbon monoxide poisoning  
 G W STOCKWELL—9 Demonstration Ununited fractures  
 W A EVANS T LEUCUTIA and C K HASLEY—9 Demonstration Radiation and electric coagulation in malignant diseases  
 E G MARTIN—9 Demonstration Cases of dysentery treated by Bergen's method  
 J J CORBETT—9 Demonstration Management of acute proctological conditions  
 H P CUSHMAN—9 Demonstration Gynecological diagnostic methods  
 L W HAYNES—9 Demonstration Diagnosis of pregnancy  
 W T SHANNON—9 Demonstration and comparison of methods in anesthesia

## Thursday

- MAX BALLIN and associates—9 Surgical clinic  
 C W HALLIDAY and C G JENNINGS—9 Goutier clinic  
 Incidence of goiter medical aspects of goiter  
 GEORGE KAMPERMAN—9 Gynecological operations  
 WARD SEELEY—9 Demonstration Management of pelvic inflammatory disease  
 F H COLE—9 Demonstration Methods of diagnosis of ureteral obstruction  
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 R A MACARTHUR—9 Demonstration Treatment of epididymitis

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- A D LAFERTE—9 Open treatment of fractures  
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## Friday

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 W A EVANS—9 Demonstration Roentgenology of the gallbladder  
 NORMAN ALLEN—9 Diagnosis of gastric malignancy  
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 A C HALL—9 Demonstration Industrial surgery fractures of os calcis  
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 H P CUSHMAN—9 Demonstration Gynecological diagnostic methods  
 L W HAYNES—9 Demonstration Diagnosis of pregnancy  
 W T SHANNON—9 Demonstration and comparison of methods of anesthesia

## PROVIDENCE HOSPITAL

## Tuesday

- EDWARD PALMER—9 General surgery  
 WILLIAM A HAFER—9 Gynecology  
 WILLIAM E KEANE—9 Genito-urinary surgery

## Wednesday

- WILLIAM J SEYMOUR—9 General surgery  
 JOHN BELL—9 Obstetrics  
 CEDRIC P SIBLEY—9 Genito-urinary surgery  
 ALLEN McDONALD—10 30 General surgery

## Thursday

- RAYMOND ANDRIES and LOUIS MORAND—9 General surgery  
 H WELLINGTON YATES and ISAAC S GELLERT—9 Gynecology  
 JAMES MATTHEWS—9 Orthopedics  
 CHARLES J JENTGEN—10 30 General surgery

## Friday

- J A MACMILLAN—9 General surgery  
 JOHN BELL—9 Obstetrics  
 EDWARD DOWDLE—9 General surgery  
 RALPH H BOOKMEYER—10 30 General surgery

## HENRY FORD HOSPITAL

## Tuesday

- R D McCLURE and A B McGRAW—9 General surgical clinic operations and demonstration of cases  
 J P PRATT and H M NELSON—9 Gynecological clinic operations and demonstration of cases  
 JOHN K. ORMOND—9 Urological clinic operations and demonstration of cases  
 C W PEABODY—9 Orthopedic clinic, operations and demonstration of cases

## Wednesday

- R D McCLURE and A B McGRAW—9 General surgical clinic operations and demonstration of cases  
 J P PRATT and H M NELSON—9 Gynecological clinic operations and demonstration of cases  
 C W PEABODY—9 Orthopedic clinic, operations and demonstration of cases  
 A S CRAWFORD—9 Neurosurgical clinic operations and demonstration of cases

## Thursday

- R D McCLURE and A B McGRAW—9 General surgical clinic operations and demonstration of cases  
 J P PRATT and H M NELSON—9 Gynecological clinic, operations and demonstration of cases  
 JOHN K. ORMOND—9 Urological clinic, operations and demonstration of cases  
 C W PEABODY—9 Orthopedic clinic, operations and demonstration of cases

## Friday

- R D McCLURE and A B McGRAW—9 General surgical clinic operations and demonstration of cases  
 J P PRATT and H M NELSON—9 Gynecological clinic, operations and demonstration of cases  
 C W PEABODY—9 Orthopedic clinic operations and demonstration of cases  
 D S CRAWFORD—9 Neurosurgical clinic, operations and demonstration of cases

## Demonstrations—Daily 9 a m

- R S SIDDALL and R J SISSON Obstetrical clinic incidence of late toxemia of pregnancy and significance for subsequent pregnancy ethylene anesthesia in obstetrics pathology of the placenta and umbilical cord developmental anomalies of the fetus and other pathological specimens  
 F J SLADEN R H DURHAM A C KOEHLER R I JOHNSTON and associates Demonstrations with exhibits Graphic illustration of the organization of the hospital from the standpoint of the patient the curriculum of the interne critique of record methods with exposition of a new method the pre-operative problem of hypertension to the surgeon and after results direct capillary studies, congenital deformities of the gall bladder  
 F R MENAGH S J JOYCE and associates Demonstrations with exhibits Etiology of angioneurotic edema dermatological lesions (lantern slides) relationship of Kahn test to clinical syphilis (Dr Hartman)  
 J G MATEER W S HENDERSON and associates Demonstrations with exhibits Clinical evaluation of chole cystography based on 1000 cases method of preparation of patients for cholecystography general method of gastro-intestinal survey, method of differentiation of cases of jaundice, pre-operative problem of pyloric obstruction

- D P FOSTER Demonstrations with exhibits Outpatient department studies in metabolism with examples, obesity in relation to blood pressure use of glucose in treatment of nephritis, cases of diabetes and pregnancy  
 T J HELDT GROVES SMITH and associates Demonstrations with exhibits The aid of the neuropsychiatric service to the surgeon and obstetrician  
 F JANNEY SMITH L T COLVIN and associates Demonstrations with exhibits Heart lesions produced by deep X ray experimental and clinical study (with Drs Hartman, Doub and Bolliger), spontaneous hernia of lung through the chest wall treatment of Stokes Adams disease with barium chloride clinic on lipiodol injections, diagnosis of lung abscess and artificial pneumothorax  
 C M MCCOLL D S ARBUCKLE and associates Demonstration reception and handling of new patients in the outpatient department  
 L S FALLIS A BOLLIGER and F W HARTMAN Demonstration Colloidal lead treatment of carcinoma preparation and tissue reactions  
 R D McCLURE and F W HARTMAN Demonstration Blood transfusion, methods and results, a plea for standardization  
 H P DOUB Demonstration Radiological studies on thoracic tumors, development and response to de radiation  
 F W HARTMAN, A BOLLIGER and H P DOUB Demonstration Deep X ray as an agent for the production of experimental visceral disease  
 F W HARTMAN Demonstration Cytology of bone tumors  
 C Z GARBER Cytology of bone tumor

## CHILDREN'S HOSPITAL

## Tuesday

- FREDERICK C KIDNER, ROBERT V FUNSTON, and F G CURTIS—9 Orthopedic operations  
 GROVER C PENBERTHY and staff—9 General surgery of children

## Wednesday

- FREDERICK C KIDNER, ROBERT V FUNSTON, and F G CURTIS—9 General surgery  
 GROVER C PENBERTHY and staff—9 Orthopedics

## Thursday

- FREDERICK C KIDNER ROBERT V FUNSTON and F G CURTIS—9 Orthopedic operations  
 GROVER C PENBERTHY and staff—9 General surgery

## Friday

- FREDERICK C KIDNER, ROBERT V FUNSTON and F G CURTIS—9 General surgery  
 GROVER C PENBERTHY and staff—9 Orthopedics

## WOMAN'S HOSPITAL

## Wednesday

- C H JUDD—9 Gynecology

## Thursday

- SUSANNE SANDERSON—9 Gynecology

## Friday

- ARCHIBALD D McALPINE—9 General surgery  
 WYMAN BARRETT—9 General surgery

## ST MARY'S HOSPITAL

## Tuesday

- WILLIAM J. CASSIDY—9 Tumor of cerebellum toxic goiter removal of foreign body in bronchus  
 WALTER L. HACKETT—9 Resection of colon cholecystectomy appendectomy  
 LEO DRETZKA—9 Decompression in skull fracture vaginal repair toxic goiter  
 LANNES CONDIT—9 Fracture of femur (open reduction) amputation of foot trephining in skull fracture  
 ANDREW R. HACKETT—9 Pott's fracture fracture of patella open reduction of fracture of humerus  
 ARMAND KERSTEN—9 Removal of tuberculous kidney suprapubic prostatectomy epididymectomy  
 LORENZO ZIMMER—9 Watkins interposition operation for cystocele (vaginal repair) fibromyomata of uterus hysterectomy  
 JOHN CORBETT—9 Demonstration of local sacral and spinal anesthesia hemorrhoids local carcinoma of rectum resection (Miles operation) prolapse of rectum

## Wednesday

- WILLIAM J. CASSIDY—9 Appendectomy duodenal ulcer (gastro enterostomy) foreign body in knee joint (removal)  
 WALTER L. HACKETT—9 Waugh's replacement of ascending colon Finney's gastroduodenostomy myomectomy  
 LEO DRETZKA—9 Cystocele and rectocele (repair) gastric ulcer (gastric resection) tumor of pine (removal)  
 LANNES CONDIT—9 Amputation of hip joint cast for fracture of os calcis fracture of patella  
 ANDREW R. HACKETT—9 Cast of tibia open reduction of fracture of humerus appendectomy  
 ARMAND KERSTEN—9 Cystoscopy removal of tumor of scrotum drainage of bladder  
 WILLIAM A. REPP—9 Appendectomy salpingostomy for sterility amputation of cervix  
 JOHN CORBETT—9 Colostomy for carcinoma of sigmoid operation for pruritus ani

## Thursday

- WILLIAM J. CASSIDY—9 Suture of ulnar nerve brain abscess (drainage) excision of knee joint resection of rib in empyema  
 WALTER L. HACKETT—9 Thyroidectomy (adenoma) carcinoma of sigmoid ovarian cyst  
 LEO DRETZKA—9 Salpingectomy for pelvic inflammatory disease carcinoma of tongue resection of rectum for carcinoma (Miles operation)  
 LANNES CONDIT—9 Removal of foreign body from knee joint cast for fractured femur cast for fractured ribs  
 ANDREW R. HACKETT—9 Removal of bone plates foreign body in hand (removal) fractured tibia  
 ARMAND KERSTEN—9 Stone in ureter stone in bladder removal of tuberculous kidney  
 WILLIAM A. REPP—9 Hysterectomy appendectomy hemorrhoids  
 JOHN CORBETT—9 Hemorrhoids under local anesthesia operation for imperforate anus rectal fistula

## MICHIGAN MUTUAL HOSPITAL

- G. C. PENBERTHY and DR. SMITH—9 Daily General surgical operations and demonstration of cases Repair of lacerations amputations reduction of fractures care of ununited fractures hernia cases  
 Staff—9 Daily Demonstration in physiotherapy department

## GRACE HOSPITAL

## Tuesday

- BRUCE ANDERSON—9 Hysterectomy for fibroid  
 HERBERT W. HEWITT—9 Gastric surgery  
 IRVING A. KELLY—9 Herniotomy local anesthesia  
 HUGH A. HAGERTY—9 Fixation operation for proclivita uteri  
 MILTON A. DARLING—9 Vaginal plastic  
 FRANK E. CURTIN—9 Hibbs operation  
 EDWIN C. HOFF—9 Cholecystectomy  
 LEWIS E. DANIELS—9 Vaginal plastic  
 HAROLD L. MORRIS—9 Operative procedures for bilateral renal calculi  
 LEROY W. HULL—9 Scrotal surgery epididymectomy epididymotomy

## Wednesday

- HAROLD K. SHAWAN—9 Thyroidectomy  
 FRANK A. KELLY—9 Herniotomy local anesthesia  
 ROBERT J. PALMER—9 Pylorectomy  
 BRUCE ANDERSON—9 Vaginal plastic  
 LEWIS E. DANIELS—9 Hysterectomy for carcinoma of cervix  
 CHARLES S. KENNEDY—9 Gastric surgery  
 WILLIAM A. HUDSON—9 Pneumonecstomy  
 MILTON A. DARLING—9 Demonstration of lipiodol in section of fallopian tubes  
 HARRY W. FLAGGEMEYER—9 Prostatectomy  
 GEORGE C. BURR—9 Cystoscopy with local anesthesia

## Thursday

- HERBERT W. HEWITT—9 Cholecystectomy  
 BRUCE ANDERSON—9 Abdominal hysterectomy for fibroid  
 WILLIAM E. BLODGETT—9 Albee operation  
 HAROLD K. SHAWAN—9 Thyroidectomy  
 GEORGE P. MYERS—9 Open reduction with bone graft for fracture of femur  
 HUGH A. HAGERTY—9 Bilateral salpingo oophorectomy  
 FRANK A. KELLY—9 Herniotomy  
 L. W. HARTMAN—9 Amputation of leg at hip joint  
 R. L. CUMMINGS—9 Tuberculosis of genito-urinary tract nephrectomy dermoid cyst of scrotum

## Friday

- HAROLD K. SHAWAN—9 Thyroidectomy  
 ROBERT J. PALMER—9 Herniotomy  
 CHARLES S. KENNEDY—9 Removal of spinal cord tumor  
 WILLIAM E. BLODGETT—9 Hibbs operation  
 FRANK E. CURTIS—9 Talipes equinovarus  
 EDWIN C. HOFF—9 Operation on gall bladder and ducts  
 FRANK A. KELLY—9 Hernia local anesthesia  
 GEORGE P. MYERS—9 Resection of knee joint  
 HARRY W. FLAGGEMEYER and R. L. CUMMINGS—9 Carcinoma of prostate electrocoagulation of tumor

## ST JOSEPH'S MERCY HOSPITAL

## (Ann Arbor)

- C. C. DARLING—9 General surgical operations and demonstration of cases  
 I. D. LOREE—9 Genito urinary operations and demonstration of cases  
 C. L. WASHLER—9 Orthopedic operations and demonstration of cases  
 H. H. CUMMINGS—9 Gynecological and obstetrical operations and demonstration of cases  
 H. M. BEEBE—9 General surgical operations and demonstration of cases

## DETROIT RECEIVING HOSPITAL

## Tuesday

- H K SHAWAN and C FREMONT VALE—9 General surgery  
 H F DIBBLE—9 Gynecology  
 H W FLAGGEMEYER and R E CUMMING—9 Urology  
 W E BLODGETT—9 Orthopedics  
 O A BRINES—9 Pathological conference  
 PAUL EISEN—9 X ray demonstration

## Wednesday

- H WELLINGTON YATES—9 Gynecology  
 LEO DRETZKA and CHARLES B LAKOFF—9 General surgery  
 E G MARTIN—9 Proctology  
 W E KEANE—9 Urology  
 JAMES E DAVIS—9 Pathological conference  
 J C KENNING—9 X ray demonstration  
 ALEXANDER W BLAIN—11 General surgery

## Thursday

- W J SEYMOUR—9 General surgery  
 A D LA FERTE and L I CONNIT—9 Bone and joint surgery, open reduction of fractures  
 WARD F SEELEY—9 Gynecology  
 H K SHAWAN and C FREMONT VALE—9 General surgery  
 O A BRINES—9 Pathological conference  
 PAUL EISEN—9 X ray demonstration

## Friday

- ANGUS McILAN—9 General surgery  
 FRED H COLE—9 Urology  
 LEO DRETZKA and CHARLES B LAKOFF—9 General surgery  
 L J HIRSCHMAN and J J CORBETT—9 Proctology  
 JAMES L DAVIS—9 Pathological conference  
 J C KENNING—9 X ray demonstration

## JEFFERSON CLINIC AND DIAGNOSTIC HOSPITAL

## Tuesday

- ALEXANDER W BLAIN—9 Thyroidectomy for Graves disease  
 IRA G DOWNER—10 Cholecystectomy and appendectomy  
 LEO E GRAJEWSKI—11 Bilateral epididymectomy, chronic epididymitis  
 DAVID T HERON—12 Oral surgery

## Wednesday

- PAUL EISEN—9 X ray demonstration, gastric ulcer  
 ALEXANDER W BLAIN—10 Gastric resection for gastric ulcer  
 OSBORNE A BRINES—11 Direct blood transfusion  
 WEE K LIM—11 Industrial surgery

## Thursday

- IRA G DOWNER—9 Gastro-enterostomy duodenal ulcer  
 ROY C KINGSWOOD—10 Abdominal hysterectomy, fibroid of uterus  
 OSBORNE A BRINES—11 Direct blood transfusion  
 HARVEY BLAIN—12 Oral surgery

## Friday

- ALEXANDER W BLAIN—9 Thyroidectomy adenoma of the thyroid  
 IRA G DOWNER—10 Herniotomy, ventral hernia  
 LEO E GRAJEWSKI—11 Nephrectomy pyonephrosis  
 ROY C KINGSWOOD—12 Vaginal repair lacerations

## ST JOSEPH'S MERCY HOSPITAL

## Tuesday

- GEORGE BAKER—9 Operations for mediastinal tumors and ventral hernia  
 A L GIGNAC and B B BRUNKE—9 General surgical clinic  
 DR CUMMINGS—9 Urological clinic

## Wednesday

- JOSEPH H ANDRIES—9 General surgical clinic  
 I THOMPSON and C J FOLEY—9 Gynecological clinic  
 uterine suspension and lacerations  
 F ROBERTS—9 Urological clinic

## Thursday

- WILLIAM HACKETT—9 Chronic appendicitis  
 HUGH HARRISON—9 General surgical clinic  
 H MALEJAN—9 General surgical clinic

## Friday

- D C BAUMGARTNER—9 Surgery of the gall bladder  
 F PURCELL—9 Orthopedic clinic  
 E LYNCH—9 General surgical clinic

## EVANGELICAL DEACONESS HOSPITAL

## Tuesday

- EIDEN C BAUMGARTEN and RUDOLPH L PFEIFFER—9 Operations on gall bladder and female pelvis

## Wednesday

- ALFRED H WHITTAKER and JACOB MANTING—9 Demonstration of fracture cases and operative work on fractures

## Thursday

- LESLIE HENDERSON and DANIEL LEITHAUSFR—9 Cases of gastric and duodenal ulcer, operations

## Friday

- ROBERT T TAPERT and LAWRENCE N HOST—9 Operations on thyroid and female pelvis

## HIGHLAND PARK GENERAL HOSPITAL

## Tuesday

- WILLIAM R MCCLURE—9 Fracture clinic

## Wednesday

- WILLIAM HUDSON—9 Surgery of non tuberculous suppurative disease of the lung

## Thursday

- FRANK C WITTER—9 Gynecological and surgical clinic

## Friday

- G VAN AMBER BROWN—8 Plastic pelvic surgery, treatment of malignancy of uterine cervix

## SURGERY OF THE EYE EAR NOSE, THROAT, AND MOUTH

## HARPER HOSPITAL

## Tuesday

- GEORGE FROTHINGHAM and associates—2 Eye clinic operations presentation of cases glaucoma  
 H LEE SIMPSON—2 Ethmoid and phenoid diagnosis headache originating from nasal conditions  
 JACOB WENDEL—2 Mastoid postoperative complications  
 R H PINO and R J SISSON—2 Slit lamp technique and fundus examinations  
 PARKER HEATH—2 Arteriosclerotic changes in the fundus  
 W A DEFNET E D KANAGA and ARTHUR HALE—2 Diagnostic demonstrations  
 WILLIAM EVANS— Exhibit of mastoid X ray plates

## Wednesday

- DON M CAMPBELL, DUNCAN CAMPBELL and associates—2 Eye clinic industrial diseases of the eye  
 HERMON SANDERSON—2 Sinus disease—surgical and non surgical treatment  
 J MILTON ROBB—2 Spreading osteomyelitis of the skull  
 WILLIAM EVANS— Exhibit of mastoid X ray plates  
 F L RYERSON—2 Demonstration of fundus cases  
 LEE LAIRD C C WALKER and R E ANSLOW—2 Diagnostic demonstrations

## Thursday

- GEORGE FROTHINGHAM and associates—2 Eye clinic operations presentation of cases glaucoma  
 H LEE SIMPSON—2 Ethmoid and sphenoid diagnosis headache originating from nasal conditions  
 JACOB WENDEL—2 Mastoid postoperative complications  
 H H PINO and R J SISSON—2 Slit lamp technique and fundus examinations  
 PARKER HEATH—2 Arteriosclerotic changes in the fundus  
 W A DEFNET E D KANAGA and ARTHUR HALE—2 Diagnostic demonstrations  
 WILLIAM EVANS—2 Exhibit of mastoid X ray plates

## Friday

- DON M CAMPBELL, DUNCAN CAMPBELL and associates—2 Eye clinic, industrial disease of the eye  
 HERMON SANDERSON—2 Sinus disease—surgical and non surgical treatment  
 J MILTON ROBB—2 Spreading osteomyelitis of the skull  
 F L RYERSON—2 Demonstration of fundus cases  
 LEE LAIRD C C WALKER and R E ANSLOW—2 Diagnostic demonstrations  
 WILLIAM EVANS—2 Exhibit of mastoid X ray plates

## ST JOSEPH'S MERCY HOSPITAL

## Tuesday

- EUGENE SMITH JR—2 Eye ear nose and throat clinic.

## Wednesday

- THOMAS KEATING—2 Operations for trachoma plastic surgery of the nose

## Thursday

- WILLIAM BEERY—2 Eye ear nose and throat clinic

## Friday

- J M GRAFT—2 Eye ear nose and throat clinic.

## UNIVERSITY HOSPITAL

## (Ann Arbor)

## Tuesday

- WALTER R PARKER GEORGE SLOCUM and MALCOLM BOURNE—1 30 Eye operations Cataract extractions simple combined Knapp  
 R B CANFIELD A C FURSTENBURG and J E CROW SHORE—1 30 Otolaryngological clinic Diseases of larynx and bronchi with special reference to treatment of malignant disease of the larynx.

## Wednesday

- WALTER R PARKER GEORGE SLOCUM and MALCOLM BOURNE—1 30 Eye operations Irrectomy trephine cyclodialysis extirpation of lachrymal sac  
 R B CANFIELD A C FURSTENBURG and J E CROW SHORE—1 30 Otolaryngological clinic Diseases of larynx and accessory sinuses observation of the treatment of atrophic rhinitis

## Thursday

- WALTER R PARKER GEORGE SLOCUM and MALCOLM BOURNE—1 30 Eye operations Anterior sclerotomy skin muscle operation for entropion, Hess operation for ptosis enucleation with glass ball implant.  
 R B CANFIELD A C FURSTENBURG and J E CROW SHORE—1 30 Otolaryngological clinic Infections of the temporal bone complications, with special reference to treatment of sinus thrombosis and septicæmia

## JEFFERSON CLINIC AND DIAGNOSTIC HOSPITAL

## Tuesday

- WILSON RANDOLPH—2 Chronic suppurative otitis media radical mastoidectomy  
 F T MUNSON—2 Ivory implanted in cases of osses

## Wednesday

- F T MUNSON—2 Tonsillectomies under local anesthesia

## Thursday

- GEORGE RENAUD—2 Conservative methods in treatment of upper respiratory conditions

## Friday

- WILSON RANDOLPH—2 Extirpation of nasolachrymal duct

## ST JOSEPH'S MERCY HOSPITAL

## (Ann Arbor)

- GEORGE SLOCUM Eye clinics operations and demonstration of cases

- R B CANFIELD Nose and throat clinics operations and demonstration of cases

- D W MYERS—Eye ear nose and throat clinics, operations and demonstration of cases

## MICHIGAN MUTUAL HOSPITAL

- HOWELL L BEGLE—10 daily Routine care of patients with injured eyes Discussion of industrial problems relative to injury of the eyes.

## GRACE HOSPITAL

*Tuesday*

- VOSS HARRELL—2 Surgery of ethmoid  
 RAY W HUGHES—2 Surgery of maxillary sinus  
 JOHN E GLEASON—2 Plastic surgery of nose and face

*Wednesday*

- WILLIAM FOWLER—2 Tonsillectomy Sluder method  
 NEIL BENTLEY—2 Tonsillectomy LaForce method  
 CHARLES C MCCLELLAND—2 Tonsillectomy, dissection, gas anesthesia

*Thursday*

- CHARLES C MCCLELLAND—2 Surgery of the mastoid  
 EMIL AMBERG—2 Surgery of the mastoid  
 L E GRANT—2 Surgery of ocular muscles

*Friday*

- FRED JOHNSON—2 Surgery of lachrymal sac  
 NEIL BENTLEY—2 Tendon tucking and operation for squint  
 JOHN E GLEASON—2 Surgery of larynx

## DETROIT EYE, EAR, NOSE AND THROAT HOSPITAL

*Tuesday*

- BURT R SHURLY—2 Surgical removal of papillomata of the larynx, intubation, tracheotomy mastoidectomy thyroidectomy

*Wednesday*

- O J SHORE—2 Radiology of sinuses and mastoid  
 C B LAKOFF—2 Surgery of the head  
 DUNCAN A CAMPBELL—2 Mastoid surgery

*Thursday*

- C B GAINES—2 Demonstration of various methods of tonsillectomy  
 F L RYERSON—2 Septum operations  
 R J HARDSTAFF—2 Septum operations

*Friday*

- E S BULLOCK—2 Artificial pneumothorax in relation to surgery of the chest  
 R W GILLMAN—2 Jejunostomy treatment of chronic trachoma  
 W A DEFNET—2 Clinical demonstration

## ST MARY'S HOSPITAL

*Tuesday*

- WILSON RANDOLPH—2 Mastoidectomy Enucleation of lachrymal sac

*Wednesday*

- EUCLIDE V JOINVILLE—2 Tonsillectomy, snare method, general and local anesthesia Cataract, congenital dissection  
 RAYMOND J Sisson—2 Advancement and tenotomy

*Thursday*

- BEN F GLOWACKI—2 Diagnostic laryngoscopy Maxillary antrum Caldwell Luc operation

*Friday*

- T P CLIFFORD—2 Submucous resection Tonsillectomy and adenoidectomy

## HENRY FORD HOSPITAL

*Tuesday*

- K W COSGRAVE and W B HUBBARD—2 Chemical burns of the eye with experimental study  
 W T GARRETSON—2 Modification of the LaGrange operation in simple glaucoma

*Wednesday*

- E L WHITNEY and G C HARDIE—2 Some interesting tonic amblyopias with accompanying charts  
 W T GARRETSON—2 Rib cartilage graft in the orbit (moving pictures)

*Thursday*

- E L WHITNEY and H P DOUB—2 Diagnosis of polyp in the antrum by X ray and verified by radical maxillary operation  
 W T GARRETSON—2 Lipoma of the oesophagus

*Friday*

- W T GARRETSON—2 Treatment of laryngeal abductor paralysis  
 E L WHITNEY and W A SCHAEGER—2 Interocular foreign bodies their treatment, with a report of cases

## PROVIDENCE HOSPITAL

*Tuesday*

- R E MERCER—2 Demonstration of Mercer's antrum tube Bilateral abductor paralysis Radical ethmoidectomy

*Wednesday*

- DONALD M GRAHAM—2 Oral surgery  
 WILLIS POTTER—2 Technique of radical ethmoid and sphenoid operations Radical mastoid operation Tonsillectomy under local anesthesia  
 ROBERT BEATTIE and RAY CONNOR—2 Eye ground clinic

*Thursday*

- WILLIAM P WOODWORTH—2 Submucous resection Adenoidectomy under ethyl chloride  
 ROBERT BEATTIE and RAY CONNOR—2 Eye ground clinic

*Friday*

- A O BROWN—2 Tonsillectomy under local and general anesthesia Simple mastoidectomy

## CHILDREN'S HOSPITAL

*Tuesday*

- HOWELL L BEGLE and R Sisson—2 Eye clinic, ward rounds fundus examinations  
 JACOB S WENDEL—2 Mastoid complications

*Wednesday*

- R Sisson—2 Eye operations  
 WILLIAM S GOVNE—2 Mastoiditis in infants

*Thursday*

- Drs WALKER and O HORA—2 Eye clinic ward rounds fundus examinations  
 DOV M HOWELL—2 Accessory sinus disease in children

*Friday*

- HOWELL L BEGLE—2 Eye operations  
 J B NORTON—2 Treatment of chronic otitis media in children



## HIGHLAND PARK HOSPITAL

*Tuesday*

- DOV CONHOE—2 Operation Muscle advancement for strabismus Demonstration Monocular exophthalmus retinitis pigmentosa coloboma of the choroid  
W O MERRILL—2 Needle operation for cataract

*Wednesday*

- F F POOS—2 Tonsillectomies under gas anaesthesia demonstration of tuberculous eye lesions  
C T STUBBS—2 Submucous resection of the nasal septum

*Thursday*

- DOV CONHOE—2 Radical operation for maxillary antrum  
W O MERRILL—2 Tonsillectomies modified Crowe method

*Friday*

- W O MERRILL—2 Radical mastoid operation

## DETROIT RECEIVING HOSPITAL

STAFF—Daily 2 (a) Meeting in staff room for discussion of material to be presented in operating rooms (b) Clinical surgical and anatomical demonstrations in operating rooms as follows

- J M ROBB and DOV M HOWELL Radical frontal sinus operations  
I S SCHEMBECK Tonsillectomies local and general anaesthesia  
C F McCLINTOCK Stellate cervical ganglionectomy  
JOHN M CARTER Mastoid drainage problems X ray and surgical demonstrations of tear sac

- WILLIAM S SUMMERS Slit lamp and Gullstrand ophthalmoscopic demonstrations  
RALPH H PINO and HAROLD D JUND Demonstrations complete conjunctival flap in eye injuries special eye dissections  
J H SHACKELFORD Oral surgery Fractures of the maxilla and mandible  
DOV M CAMPBELL Otological operations and demonstration of cases

## EVANGELICAL DEACONESS HOSPITAL

*Tuesday*

- CLIFFORD F BRUNK—2 Tonsillotomies Modified Sluder general anaesthesia dissection local anaesthesia

*Wednesday*

- CLIFFORD F BRUNK—2 Intranasal cases Submucous resection of nasal septum drainage and irrigation of antri

*Thursday*

- CLIFFORD F BRUNK—2 Tonsillotomies Modified Sluder general anaesthesia dissection local anaesthesia

*Friday*

- CLIFFORD F BRUNK—2 Eye clinic Muscle operation demonstration of plastic cases

## WOMAN'S HOSPITAL

- JOHN M CARTER—2 Tuesday Tonsil clinic

## HOSPITAL STANDARDIZATION CONFERENCE

*Monday, 10 a m —Orchestra Hall*

Chairman's Address W W CHIPMAN, M D, Montreal, President

Address T K GRUBER, M D, Superintendent, Detroit Receiving Hospital, and Chairman, Detroit Hospitals Council

Introduction of Distinguished Guests

Presentation of Tenth Annual Report of the Hospital Standardization Movement FRANKLIN H MARTIN, M D, Director General, American College of Surgeons

The Application of Hospital Standardization Principles to U S Veterans Hospitals (Illustrated) B W BLACK, M D, Medical Director, United States Veterans Bureau, Washington

The Right of a Hospital to Choose its Staff JOHN A LAPP Chicago, Director, National Catholic Welfare Conference

The Adjudicating Aspect of the Staff Conference JUDGE HAROLD M STEPHENS, Salt Lake City  
Hospital Charges and Costs JOHN A McNAMARA, Chicago, Executive Editor, The Modern Hospital

The Care of the Patient of Moderate Means BERT W CALDWELL, M D, Superintendent, Gordon Keller Memorial Hospital, Tampa, Florida

General Discussion Opened by ROBERT JOLLY, Superintendent, Baptist Hospital, Houston, Texas, and President American Protestant Hospital Association

*Monday, 2 p m —Orchestra Hall*

The Art of Nursing REV C B MOULINIER, S J, Milwaukee, President Catholic Hospital Association

Fundamental Training for Nurses GEORGE W KOSMAK, M D, New York, Editor, The American Journal of Obstetrics and Gynecology

Facts and Findings Pertaining to Nursing, Gleaned from a Survey of the Hospital and Private Duty Nursing Fields from the Standpoint of the Patient, the Doctor, and the Nurse MAY AYRES BURGESS, Ph D, New York, Director of Study for the Committee on Grading of Schools of Nursing

Round Table Conference on Nursing Problems Topics to be discussed Education Requirements, Nursing Curriculum, Group Nursing, Central Nurses' Registries, State Requirements Cooperation Between the Medical and Nursing Professions, and other problems

*Tuesday, 9 30 a m —Staller Hotel**Louis J McKenney, Chairman of Board of Trustees, Highland Park Hospital, Presiding*

Basic Considerations in Selecting Trustees STEWART HAMILTON, M D, Director, Harper Hospital, Detroit

What the Trustees Should Know About a Hospital, and How Best to Secure this Information ROBERT IRWIN, Vice President of Board of Trustees, Butterworth Hospital, Grand Rapids

Functions of the Board of Trustees C H MARR, Chairman of Board of Trustees, Wvondotte General Hospital

Round Table Conference Relation of the Board of Trustees Conducted by W L BABCOCK, M D, Director Grace Hospital, Detroit

(a) To the Superintendent CHARLES F NEERGAARD, New York, Trustee, Carson C Peck Memorial Hospital, Brooklyn, and Hospital Consultant

(b) To the Superintendent of Nurses MARY C WHFELER, R N, Detroit General Secretary, Michigan State Nurses' Association

(c) To the Medical Staff SAMUEL JACKSON, Tacoma, Chairman of Board of Trustees, Tacoma General Hospital

General Discussion NEWTON E DAVIS, Chicago Corresponding Secretary of the Board of Hospitals Homes and Deaconess Work of the Methodist Episcopal Church, and A C GALBRAITH Toronto Superintendent, Western Hospital

*Tuesday 2 p m —Staller Hotel*

W H Conley, M D, General Medical Superintendent, Department of Public Welfare New York, Presiding

The Compilation of Statistics as a Guide to Medical Efficiency CHARLES EATON PHILLIPS, M D, Attending Surgeon, Los Angeles General Hospital

- Medicolegal Responsibilities of Hospitals JUDGE HAROLD M STEPHENS Salt Lake City  
 The Emergency Department in the Hospital (Illustrated) PHILLIP H KREUSCHER M D Chicago  
 Professor of Clinical Orthopedic Surgery Loyola University School of Medicine  
 Advantages of Autopsies BOWMAN C CROWELL M D, Chicago Associate Director American College of  
 Surgeons and Director of Clinical Research  
 Means of Securing Autopsies RALPH G MILLS M D Pathologist Mayo Clinic Rochester  
 A Minimum Standard for Physical Therapy (Illustrated) JORV S COULTER, M D Chicago Assistant  
 Professor of Physical Therapy Northwestern University Medical School  
 General Discussion Opened by A G BARRETT M D West Baltimore President Medical Committee  
 West Baltimore General Hospital and EDGAR A BOGOCK M D Denver Superintendent Colorado  
 General Hospital

*Wednesday 9 30 a m—Statler Hotel*

- George F Frothingham M D Chief of Department of Ophthalmology Rhinology and Otolaryngology  
 Harper Hospital Detroit Presiding  
 Standardization of Special Departments for Eye Ear Nose and Throat Patients in General Hospitals  
 Presentation of a Minimum Standard for General Hospitals Caring for Eye Ear Nose and Throat Patients  
 JOSEPH C BECK M D, Chicago Associate Professor of Otolaryngology University of Illinois College of  
 Medicine  
 Discussion opened by JON D COURTEY M D Ottawa Ophthalmologist Ottawa Civic Hospital  
 Organization THOMAS E CARMODY M D Denver Professor of Oral Surgery and Rhinology, University  
 of Denver Dental Department  
 Personnel W W PEARSON M D Des Moines Otolaryngologist Congregational Mercy and Lutheran  
 Hospitals  
 Discussion opened by E M SHANKLIN M D Hammond Indiana Ophthalmologist St Margaret's  
 Hospital  
 Records PERRY G COLDSMITH M D Toronto Professor of Otolaryngology University of Toronto  
 Faculty of Medicine  
 Staff Conference WALTER H SNYDER M D Toledo Ophthalmologist Flower Hospital  
 Discussion opened by John C McREYNOLDS M D Dallas Texas Ophthalmic and Aural Surgeon  
 St Paul's Sanitarium  
 Instruction of Nurses and Internes AUSTIN A HAYDEN M D, Chicago Ophthalmologist and Otolaryn-  
 gologist St Joseph's Hospital

*Wednesday— 8 p m*

- Demonstrations in Hospital Planning and Construction Equipment Organization Administration and  
 Procedures—Conducted by the Detroit and Ann Arbor Hospitals

*Thursday 9 30 a m—Statler Hotel*

- Round Table Conference—Conducted by M T MACEachern M D Chicago Associate Director Amer-  
 ican College of Surgeons and Director of Hospital Activities Topics Everyday Problems of Ho-  
 pitals—Factors Determining Hospital Efficiency Factors Influencing Average Days Stay of Patients  
 in Hospitals Ideal Organization of the Medical Staff in an Open Hospital Staff Conference Procedure  
 Essential Requirements for Accurate and Complete Case Records Measures to Insure Professional  
 Efficiency Minimum Standard for Maternity Service in General Hospitals Status Functions and  
 Relations of the Dietitian to the Hospital Administration Standardization of Ward Supplies and  
 Routine Educational Publicity for Hospitals

*Thursday— 8 p m*

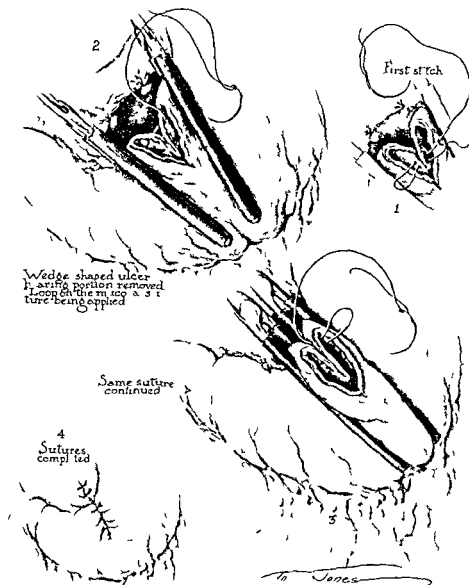
- Demonstrations in Hospital Planning and Construction Equipment Organization Administration and  
 Procedure—Conducted by the Detroit and Ann Arbor Hospitals



# LUKENS PICTORIAL TECHNIQUE

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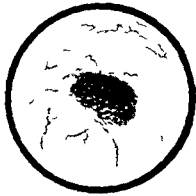
### J WEDGE RESECTION FOR ULCER OF STOMACH



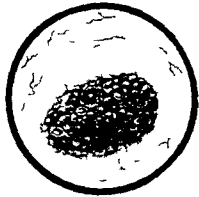
### *Sutures with a Reputation*

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Case 1 A tuberculoma surrounding and occluding the left ureteral orifice in a case of left renal tuberculosis. The remainder of the bladder was essentially normal.



Case 2 An inflammatory reaction in the wall of the bladder secondary to a contiguous tuberculous inflammation of the remaining portion of the adnexa uteri.



Case 3 The left margin of an extensive inflammatory reaction in the wall of the bladder secondary to an adherent inflamed left tube and ovary (probably tuberculous).

# SURGERY, GYNECOLOGY AND OBSTETRICS

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NUMBER 4

## INFLAMMATORY LESIONS OF THE BLADDER SIMULATING NEOPLASM

### REPORT OF THREE CASES

By J J JOELSON M D AND W E LOWER M D F A C S CLEVELAND OHIO  
From the Department of Surgery Western Reserve University School of Medicine and Lakeside Hospital

**I**NFLAMMATORY lesions of the bladder which closely simulate true neoplasm are not common. Generalized inflammation, whether of the type of proliferative cystitis or bullous oedema, or the reaction about the orifice of a vesical diverticulum or a vesico-intestinal fistula, presents a distinct condition usually recognizable by cystoscopy. The discrete inflammatory lesion as exemplified in the following case reports seems to offer so few differential signs from true tumor that it deserves further study. Those cases already reported emphasize the great difficulty of diagnosis. Cystoscopy presents few specific signs, and many of the cases heretofore reported have been diagnosed as neoplasm. Roth (11) mentions briefly a vegetative process occurring in tuberculous bladders "which simulates villous or papillomatous growths so closely as possibly to cause some confusion." Litchem (9) makes a similar statement. Many other writers have described areas of granulation tissue occurring in tuberculous bladders (4, 5, 6, 7, 10). Thomas (12) reports a non-tuberculous granuloma of the bladder. Kelleuthner (8) reports two cases in which he diagnosed the inflammatory reactions at the mouths of diverticula as carcinomata. Syphilitic tumors of the bladder also occur (2, 3, 8).

Cimino (1) recently has reported five cases of inflammatory tumors of the bladder. He divides these lesions into two classes viz, (a) inflammatory tumors of the wall of the bladder (ligneous phlegmons), and (b) inflammatory tumors extending into the cavity of the bladder. Three of his cases were of the former type and since this lesion is apparently quite different from the localized inflammatory tumor of the bladder, these cases need not be discussed. His other two cases, however, were of the latter type and may be briefly summarized as follows:

One occurred in a woman 76 years of age who, following division of an anal fissure, began to have strangury, frequent and painful desire to urinate, false incontinence and lancinating pain in the bladder. The urine, which was at first purulent, became greenish, stringy, and putrid. There was also hematuria. On vaginal examination, a mass could be felt in the bladder. Cystoscopic examination showed a sessile, grayish rose colored tumor, the size of a large almond. It had a fleshy appearance. Its surface was granular and covered in spots with purulent fibrinous shreds. The tumor had a large base situated on the trigone and was raised about 3 centimeters above the mucosa. The diagnosis of carcinoma of the bladder was made and, because of the patient's age, the condition was considered inoperable. With local treatment, however, the patient improved rapidly. Another cystoscopic examination made 4 months later, showed that the tumor had entirely disappeared, and in its place there was only



a slight irregular wrinkling of the hyperplastic and hyperæmic mucosa.

The other case occurred in a soldier 23 years of age. This patient apparently had received a penetrating wound of the bladder 2 years previously. Urine drained from this wound several months before it healed but since that time he had noticed terminal hæmaturia. Cystoscopic examination showed a rose colored tumor on the left lateral wall which resembled a mulberry. The surface of the tumor was covered in some small areas by a grayish membrane and some bleeding points were also present. Roentgenograms showed the metal bullet to be extravascular. The patient refused operation but returned one year later in the same condition. The cystoscopic appearance of the tumor was unchanged. At operation the tumor was grasped with forceps and as a result of this it separated close to its base. The base of the tumor which remained attached to the wall of the bladder contained a small bit of woollen cloth. The histological examination of the tumor showed a chronic inflammatory process from the presence of a foreign body.

We have three cases to report. They illustrate well the difficulty in diagnosis but at the same time they emphasize points which if duly considered should assist in making an accurate diagnosis. We ourselves benefited to such a degree from Case 1 that we were able to appreciate the true condition in Case 2 though we again failed in Case 3. The operation in Case 3 however was probably necessary since the removal of infected material lying against the bladder relieved the condition permanently.

**CASE 1.** A married Austrian woman 30 years of age came to the hospital because of frequency and dysuria.

Her past history was unimportant except for the following fact: seven years ago she had chills and fever following a stillbirth and one year later both ovaries and tubes were removed.

The present illness had a gradual onset about one year before admission to the hospital. It started with frequency, nocturia and burning on urination. These symptoms steadily increased in severity. At no time did she notice hæmaturia or cloudy urine.

For several weeks prior to her admission the patient was observed in the gynecological dispensary. In this department repeated urinalyses at no time showed pus cells or other abnormal urinary constituents. A cystoscopic examination done in the dispensary showed a tumor in the region of the left ureteral orifice.

Upon admission to the urological service the physical examination was negative except that the patient was pale and thin.

Laboratory findings: blood Wassermann negative; hæmoglobin 80 per cent; leucocyte count 6700; urine yellow, clear acid; specific gravity 1010; albumin 0; sugar 0. Microscopic examination showed a few white blood cells, no red blood cells, no casts. Cultures made from urine from bladder were sterile.

Roentgenograms of the urinary tract showed no shadows of increased density. The outlines of both kidneys were plainly visualized. The right appeared normal but the left showed a marked irregularity consisting of a deep notch in the convex border of the kidney.

Cystoscopic examination showed that the vesical capacity and tone were normal. In the region of the left ureteral orifice there was seen a reddish tumor which was about 1.5 centimeters in diameter and raised about 1 centimeter above the surrounding mucosa. The tumor was sessile and its surface presented numerous rounded villi. No ulceration was present. The left ureteral orifice could not be located. The remainder of the bladder was essentially normal. The right ureteral orifice was normal.

In view of the sessile character of the tumor a diagnosis of carcinoma of the bladder was made and a suprapubic cystostomy was performed. After opening the bladder the lesion was palpated and was found to be very firm. The tumor, its surrounding mucosa and a part of the intramural portion of the ureter were excised. The cut edges of the vesical mucosa were loosely approximated and the wound was closed in the usual way. The patient made an uneventful recovery.

**Pathological report.** The specimen consisted of a piece of tissue 0.6 by 1.8 by 1.2 centimeters. It was firmly elastic in consistency. Histological examination showed one margin of the section covered with stratified vesical epithelium which overlaid a fibrous connective tissue stroma. The stroma was extensively infiltrated with small lymphocytes and a few plasma cells and polymorphonuclear leucocytes. Many typical tubercles with giant cell formation were scattered throughout the tissue (Figs. 1 and 2).

Nine days after the operation because of the histological diagnosis of tuberculosis another cystoscopic examination was made. The urine from the bladder was now turbid with pus and a fairly marked degree of generalized cystitis was present. In the region of the left ureteral orifice the previous site of the tumor a wide deep wound was seen. Some sloughing tissue was attached to the edges of this wound and a moderate degree of bullous oedema surrounded it. The left ureteral orifice could not be located. The right orifice appeared normal and was easily catheterized. The urine from the right kidney was grossly clear and microscopically negative. One cubic centimeter of phenolsulphonaphthalein was injected intravenously. It appeared in the urine from the right kidney in 2 minutes and 40 per cent was excreted in 15 minutes.

Four days later another cystoscopic examination was made, and indigocarmine was injected intra-

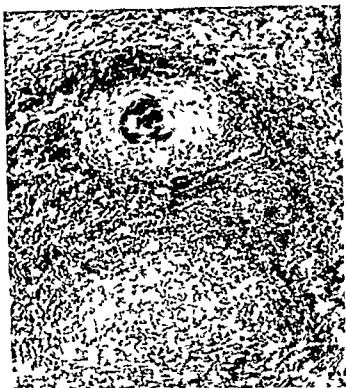


Fig 1 Photomicrograph showing a typical tubercle with giant cell formation in the vesical wall  $\times 150$

muscularly. The dye could be seen in the urine coming from the right ureteral orifice 10 minutes after its injection. On the left side, however, the ureteral orifice could not be located since no dye could be seen coming from this region, although it was carefully sought for 30 minutes.

The patient was discharged 3 weeks after operation. During the following 2 months she continued to have frequency, nocturia, and persistent pyuria. She was then admitted to the hospital for another complete urological examination.

Cystoscopic examination this time revealed a depressed scar in the region of the left ureteral orifice. This was completely epithelized and apparently marked the site from which the tumor had been excised. The left ureteral orifice appeared as a patulous opening at the bottom of this depression. Both ureters were catheterized. A definite but passable obstruction was met 1 centimeter above the left ureteral orifice. A normal intermittent flow was obtained from both kidneys. The urine from the right side was grossly clear and microscopically negative. A careful search for tubercle bacilli in this urine did not reveal any acid fast organisms. The urine from the left kidney was grossly turbid and microscopically showed many pus cells. Numerous tubercle bacilli were found in the sediment of this urine. One cubic centimeter of phenolsulphone phthalein was injected intravenously. It appeared from the right kidney in 3 minutes and 32 per cent was excreted in 15 minutes. The time of appearance on the left side was 4 minutes but this kidney excreted only 5 per cent of the dye in 15 minutes. A



Fig 2 Photomicrograph showing relation of a tubercle to the vesical mucosa  $\times 300$

pyelogram of the left kidney showed a small pelvis with upper calyces almost completely obliterated but normal middle and lower calyces. The ureter was markedly dilated.

Röntgenograms of the chest showed some calcified areas in both hilar regions but were otherwise normal.

A left nephrectomy was advised, but the patient refused operation. She was, therefore, discharged and was not seen again for 10 months (1 year after operation).

At this time she was still having frequency and nocturia. Her general condition was good. On cystoscopic examination a mild generalized cystitis was seen. The region of the left ureteral orifice was scarred and puckered but there was no suggestion of any tumor. The left ureteral orifice could not be found.

The urine from the bladder was hazy with pus. The urine from the right kidney was normal.

The patient still refused a nephrectomy and was therefore started on ultraviolet therapy.

**CASE 2** A married negress 24 years of age came to the hospital because of frequency and dysuria.

About 1 year before admission to the urological clinic she was on the gynecological service of the Lakeside Hospital. At that time she complained of lower abdominal pain and by vaginal examination bilateral tubo-ovarian masses were felt. She did not have any vesical symptoms however and the urine was normal. A curettage and a bilateral salpingo-oophorectomy were done but a small part of the right tubo-ovarian mass could not be removed. Following the operation an abscess formed in the upper portion of the wound which resulted in a persistently discharging sinus. The pathological diagnoses of the removed specimens were tuberculous salpingitis, tuberculous oophoritis and tuberculous endometritis.

For 11 months following operation she was free from all symptoms but the abdominal sinus continued to discharge small amounts of pus. Repeated vaginal examinations made during this interval showed a persistent indurated slightly tender mass in the right side of the cul-de-sac. About a year after the operation frequency, dysuria and nocturia developed. These symptoms steadily became more severe and she was therefore admitted to the urological clinic. The urine at this time contained a moderate number of pus cells but was negative for tubercle bacilli both by microscopic examination and guinea pig inoculation. The blood Wassermann was negative.

**Cystoscopic examination.** The capacity and tone of the bladder were normal. On the posterior wall of the bladder and to the right of the midline a definitely circumscribed rose colored tumor was seen. It was about 2 centimeters in diameter and raised about 1 centimeter above the surrounding mucosa. The tumor was sessile and made up of large club shaped villi. On close vision some of these villi appeared to be cystic. The remainder of the bladder was normal. The urine from the bladder was turbid and microscopic examination of the sediment showed pus cells to be present. The urine from each kidney was normal but cultures made of the urine from both kidneys and the bladder showed a growth of bacillus coli from each of the three specimens.

A vaginal examination done as soon as the cystoscopic examination had been completed showed that the pelvic mass occupied a position corresponding to the region immediately posterior to the vesical lesion. In view of the cystic appearance of some of the villi of the tumor and its contiguity with the inflammatory pelvic mass the lesion was diagnosed as an inflammatory reaction in the bladder wall.

The patient was advised to have another pelvic operation in order that the inflammatory mass could be removed but this she refused to do. She has been followed in the Out Patient Department for the past 15 months. Her vesical symptoms have disappeared but the pelvic mass persists and

the abdominal sinus still discharges small amounts of pus.

The last cystoscopic examination which was made 14 months after the first showed the tumor to be the same size and in the same position. The surface of the lesion however had definitely changed. Its color was bright red but no villi vesicles nor edema were present. The remainder of the bladder was normal. The urine contained a moderate number of pus cells.

**CASE 3** A married Hungarian woman 27 years of age came to the hospital because of marked frequency and dysuria.

She has had two children and both are living and well. Her past history was unimportant until the birth of her second child 11 months ago. This labor was apparently normal and although it was not followed by any fever or definite illness still she has not felt well since. Menstruation began again 3 months ago and has been regular but painful.

The present illness had a gradual onset 2 weeks before admission to the hospital when she began to be troubled with frequency, nocturia, dysuria and pain in the lower abdomen. The abdominal pain was dull and constant. These symptoms steadily became more marked but the dysuria became extremely severe and was associated with tenesmus. On several occasions the patient noticed hematuria.

The physical examination showed a thin and very pale woman. The temperature, pulse and respirations were essentially normal. The heart and lungs were normal. In the lower abdomen a firm irregular fixed and slightly tender mass was felt. This mass was situated mainly in the left lower quadrant but also extended into the right lower quadrant for 5 centimeters beyond the midline. It seemed to rise out of the pelvis and extended from the symphysis pubis to a point 5 centimeters below the umbilicus. On vaginal examination a fixed tender mass could be felt bulging into the anterior vault of the vagina and extending laterally to the left. It seemed to be situated in the region of the base of the bladder.

**Laboratory findings.** Hemoglobin 70 per cent, leucocyte count 15,000, urine turbid and specific gravity 102, albumin heavy, trace sugar 0. Microscopic examination showed numerous pus cells, no red blood cells, no casts. No acid fast bacilli could be found in the urine on two examinations. I henolsulphonethalein test 60 per cent excreted in 2 hours and 10 minutes. Blood urea 56 milligrams per 100 cubic centimeters. Blood Wassermann negative.

**Cystoscopic examination.** The instrument was introduced without meeting any obstruction. The capacity of the bladder was limited and marked vesical spasm was present. An extensive tumor was seen involving the posterior and left lateral walls of the bladder and also extending for a short distance on the right lateral wall. This tumor was sessile and of a reddish gray color. Its surface was covered by rounded villi. No ulceration was present. Around the edge was a moderate amount of edema.

The lesion was considered to be an extensive and inoperable carcinoma of the bladder which had grown through the wall of the bladder and had invaded the surrounding pelvic structures. To give relief from the vesical symptoms, of which the patient complained bitterly, it was thought advisable to transplant both ureters into the rectum.

**Operation.** Under nitrous oxide anaesthesia a midline suprapubic incision was made. After opening the peritoneal cavity, a large, firm, inflammatory mass was found in the left side of the pelvis. It was adherent to the bladder, sigmoid, and several loops of small intestine. After freeing these structures the left tube and ovary were found in the center of the mass. A few drops of pus were present around the tube. A left salpingo-oophorectomy was done following which the bladder was carefully palpated. A firm, indurated area could be felt in the wall of the bladder near its base, but it was not possible to determine whether this was caused by a neoplasm or an inflammatory reaction. However it was considered inadvisable to open the bladder at this time. A drain was inserted into the pelvis and the wound closed.

**Pathological report.** The sections of the tube showed a chronic inflammatory reaction with a marked infiltration of mononuclear cells. The lesion was suggestive of tuberculosis but there was not enough evidence present to make a positive diagnosis.

The postoperative course was stormy. On the first day after operation, the temperature rose sharply to 40 degrees C and then gradually came down to a lower level. It never reached normal, however, and for the remainder of her hospital stay (38 days) it fluctuated between 37 and 38.5 degrees C. During this time, a moderate amount of pus continued to discharge from the drainage tract, the granulations of which were pale and watery. Soon after the operation the vesical symptoms began to subside, and within 2 weeks they disappeared. The urine at this time contained very few leucocytes.

Eighteen days after the operation a cystoscopic examination was again made. The site of the tumor now showed only a localized area of congestion but there was no elevation of the mucosa nor any other condition suggestive of a tumor. The remainder of the bladder was normal.

About 1 month after operation the wound began to drain unsatisfactorily and the patient again began to have some dysuria. Cystoscopic examination at this time showed a definite bulging of the posterior wall of the bladder. On the surface of this bulging area were scattered minute nodules, but the general appearance of the lesion was different from that found at the first examination. One of these small nodules was excised for microscopic examination by means of a cystoscopic rongeur.

**Pathological report.** Serial sections made from the small piece of tissue showed vesical mucosa beneath which there was a mononuclear leucocytic

infiltration and young fibroblastic tissue. There was no evidence of tuberculosis or malignancy. Diagnosis: chronic inflammatory tissue.

A vaginal examination at this time gave evidence of a diffuse pelvic inflammatory disease. There was a small mass which could be felt through the left fornix and a larger indurated mass was present posteriorly.

Thirty-eight days after operation the patient insisted upon leaving the hospital. She was still having a slight elevation of temperature (38 to 38.5 degrees), and the wound was still discharging a moderate amount of thick pus. Her vesical symptoms, however, had again disappeared and her urine was normal.

The patient was not seen again until 8 months later. The wound had healed completely 6 weeks after she left the hospital. She looked and felt well. There were no vesical symptoms and urinalysis was negative. A cystoscopic examination was again made and a normal bladder was seen. A vaginal examination showed the uterus to be freely movable and in the midline. A small residual mass was still present in the region of the right tube, but otherwise the pelvis seemed to be normal.

Our first case is especially interesting in that a localized tuberculous lesion of the wall of the bladder resulted from a tuberculous kidney instead of the usual generalized tuberculous cystitis. A possible explanation of this is that the tuberculoma at the left ureteral orifice completely occluded this opening and thus did not permit the constant pouring into the bladder of urine infected with tubercle bacilli. In support of this view we have the following facts: (1) the urine from the bladder was free from pus until the tuberculoma was removed, (2) the unobstructed kidney was extremely hyperactive (excreted 40 per cent of phenolsulphonaphthalein in 15 minutes), (3) 2 weeks after removal of the tuberculoma the left kidney was still functioning so poorly that it apparently did not excrete any indigo carmine.

Cases 2 and 3 are instances of an inflammatory reaction being set up in the wall of the bladder by contiguity. In both cases the primary seat of the inflammation was in the adnexa uteri, one being definitely tuberculous in origin and the other probably so.

The symptoms in these three cases consisted of dysuria, frequency, nocturia, pyuria in two of the cases and in one case a history of hematuria was obtained. Cimino's cases had similar symptoms.

It can readily be seen from the symptomatology and cystoscopic findings that a differential diagnosis between an inflammatory tumor of the bladder and a true neoplasm is difficult. Our three cases were examined cystoscopically and in each a definite tumor of the bladder was seen. Cimino's cases also showed the presence of such a lesion. Incidentally this author claims that a differential diagnosis should be easy. The points which he considers important in the differential diagnosis are negative heredity, the youth of the patient, the good general condition of the patient, history of trauma to the region, infection of near or distant organs, the mild character of the hæmaturia if present, amenableness to treatment, absence of neoplastic fragments in the urine, absence of metastases and glandular enlargements and the frequent presence of fever. We feel that much stress cannot be laid on these points since one frequently sees cases of carcinoma of the bladder in which all these conditions are present except that they are not readily amenable to treatment. The youth of the patient may be against the diagnosis of carcinoma but is not sufficient to exclude this possibility.

On cystoscopic examination however these inflammatory tumors do exhibit certain characteristics which may aid in differentiating them from true neoplasms. Thus instead of having a definite papillary appearance they are made up of fairly large club shaped villi some of which may appear cystic or translucent. Their color is usually of a *rosy red hue*. They show no evidence of invading the surrounding mucosa. In none of our cases or any that Cimino reports was there ulceration present. While none of these characteristics is typical only of an inflammatory tumor still when taken altogether they may aid in correctly diagnosing a doubtful lesion of the bladder. Cimino makes the statement thus we see that the only thing necessary is to think of the possibility of the inflammatory nature of the tumor and the diagnosis can be made even without the aid of the cystoscope. In our experience, we have found that the diagnosis is not so easily made but it is of great importance that the possibility of the inflammatory nature of the tumor be borne in mind.

The symptoms may very closely simulate those of a true neoplasm and even on cystoscopic examination one may be unable to determine whether the lesion is neoplastic or inflammatory. In one of our cases (Case 1) the lesion was even considered to be a neoplasm when it was inspected and palpated at operation and only after the microscopic sections had been examined was its true nature learned. In those cases in which the tumor is suspected of not being a true neoplastic lesion a biopsy may aid in the diagnosis.

#### SUMMARY

Three cases of inflammatory tumors of the bladder are reported, one a tuberculoma and the other two local inflammatory reactions caused by contiguous inflammation.

These inflammatory lesions closely simulate a true neoplasm.

Differential diagnosis is often difficult.

The possibility of such a lesion should always be borne in mind especially in women and in those cases in which any doubt exists a biopsy may aid in arriving at the correct diagnosis.

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# URETERAL STRICTURE, ITS ANATOMICAL AND PATHOLOGICAL BACKGROUND

BASED UPON THE FINDINGS IN ONE HUNDRED CONSECUTIVE AUTOPSIES<sup>1</sup>

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THIS study was undertaken at the suggestion of Dr. Edwin Beer to test at the autopsy table, by both anatomical and pathological data, the conception lying behind that clinical entity which has been given the name of ureteral stricture. The evidence forming the background for this concept has been for the most part indirect in nature, that is, pyelographic and cystoscopic, the latter chiefly the wax bulb hang method of Hunner.

Our data—gross anatomical and gross pathological, checked by histological and clinical—were to answer these questions:

Does there exist such a pathological entity as predicated by Hunner and his followers?

If it does exist, is its incidence as great as these reports would lead us to believe?

If it exists, what role, if any, does focal infection play in its etiology?

If focal infection is found to be not a factor, what is then the true pathogenesis?

What are the finer and yet gross "physiological" anatomical structural forms that may give to pyelographic and wax bulb methods those clinical signs that are interpreted as ureteral stricture?

At this juncture a brief survey of the extensive literature is indicated. The literature groups itself into two main categories that pertaining to the gross and histological anatomy of the ureter, and that pertaining to the clinical subjects of ureteral stricture, obstruction, or stenosis.

The latter falls into two large groups relative in time to the work of Hunner, for, following the year 1910—in which Hunner first began to emphasize the importance of this subject—up to the present, there has been an abrupt increase both in the intensity of interest and in the number of clinical, postmortem, and operative reports.

## SUMMARY OF PERTINENT FACTS IN THE LITERATURE PERTAINING TO THE GROSS ANATOMY OF THE URETER

*Embryology* According to Hertwig, the ureter is derived from the wolffian duct as a bud from its dorsal surface beginning near its termination into the cloaca. This bud progresses cephalad dorsad, and mesiad and bifurcates at its upper extremity to form the primitive calyces. These jut into the mesodermal cap, the primitive ultimate renal parenchyma.

The common stalk junction of the wolffian duct (ultimate vas deferens) and the ultimate ureter are drawn into the urogenital sinus, deeper and deeper into the bladder wall, downward and forward, so that the wolffian duct orifice comes to occupy its ultimate position as the ejaculatory duct orifice in the prostatic urethra, while the ureteral orifice finds its ultimate rest superiorly, posteriorly, and laterally as the lateral extremity of the trigonum vesicae. The separation of the ultimate ureter from the ultimate vas deferens at their bladder extremities appear as the result of this drawing in process.

*Measurements of the ureter* Width Adrenal portion, 6 millimeters, upper isthmus, 3.2 millimeters, chief spindle 8 to 15 millimeters, lower isthmus, 4 millimeters (Waldeyer).

*Length* The intramural portion of the ureter is 2 centimeters long according to Papin and is 2 to 3 millimeters at the ends, being slightly dilated in the middle.

*The physiological zones of narrowing* In an unpicked autopsy series of 1,200 infants varying in age from 2½ to 9 months, English found as "normal" the following three sites of narrowing in the ureter: (1) at the pyelo-ureteral junction, (2) at a variable distance below this, (3) at the bladder entrance.

The last, namely, the narrowing at the bladder entrance, was the most constant and was found in the greater percentage of cases (figures not given). The upper two narrowings were very much less constant. This work also brought out the fact that the site of aberrant renal vessels corresponds with the site of the physiological pyelo-ureteral junction of narrowing. These facts were then sub-

<sup>1</sup>This investigation was conducted during the tenure of a Daniel Guggenheim fellowship and completed February 1926. The autopsies were conducted at the Senckenberg Pathological Institute, University of Frankfurt am Main (Director, Professor Bernhard Fischer).

stantiated by him in an unpicked series of premature and newly born infants

Robinson examined, postmortem 200 ureters filled with air with paraffin and with radio opaque substances. He also found three zones of widening and three of narrowing the latter being in the pyelo ureteral the iliac and the juxtavesical regions

Posner by epidioscopy examined post mortem a series of ureters of newly born infants and found two zones of narrowing one superiorly believed to be due to the crossing of the spermatic artery and the second inferiorly corresponding to the crossing of the ureter over the iliac artery

Schewkunenko found in a series of 213 autopsies that the juxtavesical region was the narrowest portion of the ureter outside of the ureteral orifice

*Ureteral valves* Woelfler in a postmortem series of 100 newly born infants found valve formation in 20 per cent usually 1 to 1.5 centimeters up from the ureteral orifice and in a postmortem series of 50 adults he found none with valve formation

Papin states that valves are rarely found their incidence and importance being grossly exaggerated

Basing his conclusions upon his autopsy series of 1200 infants English concluded that ureteral valves are of congenital formation and not secondary to pathological changes

It is of interest to note that George Daniel Goschwitz in 1723 first described ureteral valves in autopsy material

*The pelvic ureter* The pelvic portion of the ureter has been the subject of major study by several anatomists. According to Waldeyer it can be divided for descriptive purposes into (a) the parietal portion (from the crossing of the ureter over the iliac artery to a point opposite the ischial spine) and (b) the visceral (from the ischial spine to the ureteral orifice). On the other hand Tandler has emphasized the relationship of the female pelvic ureter to the uterine artery and has divided the pelvic ureter into (a) the supra arterial (b) the arterial or subarterial ureter and (c) the infra arterial ureter

Basing his conclusions on the careful dissections of five fresh and prepared pelvis Heiss maintained that Tandler's division

relative to the uterine artery was better than Waldeyer's for only in extreme cachexia does the pelvic ureter come into relationship with the ischial spine being usually separated from this structure by a thick pad of fatty connective tissue. He also found that the two fixed points the crossing of the ureter over the iliac vessels and the crossing of the vas deferens over the ureter are altered by distention of the bladder and rectum

Schewkunenko examined the ureters in 213 autopsies—to determine the cause of hindrance 2 to 3 centimeters up in the ureter during cystoscopic ureteral catheterization and found that (a) the mural portion of the ureter took a slanting direction through the bladder wall (b) the mural portion was widened at its middle, (c) the juxtavesical region of the ureter was the narrowest portion of the ureter outside of the ureteral orifice (d) the juxtavesical narrowing or chief isthmus, was the chief cause of hindrance and was accentuated in 3 per cent of his cases and (e) parametritis with subsequent para ureteral connective tissue changes might accentuate this hindrance this parametritis having been found in 8 to 10 per cent of females

Woelfler substantiated the above in an autopsy series of 50 adults by finding the juxtavesical region to be a site of constant narrowing

In this connection it is important to note that both Tandler and Schafer emphasize the marked increase in longitudinal musculature as the ureter reaches and traverses the bladder Schafer emphasizing the fact that in this bladder region the muscularis is entirely longitudinal

*Histology* Stoehr writing alone and Bohm and Davidoff agree in their histological descriptions of the ureter (1) a layer of stratified epithelium with surface cuboidal or columnar cells lying upon (2) a tunica propria composed of loose connective tissue carrying capillary blood and lymph vessels with few elastic fibers and few scattered lymphocytes (3) a tunica muscularis of smooth muscle bundles divided into an inner longitudinal a middle circular and an outer longitudinal layer present only in the lower half (4) an adventitia of loose fatty connective tissue carrying blood and lymph vessels and nerves

Tandler and Schafer emphasize the longitudinal muscularis in the bladder region

SUMMARY OF THE PERTINENT FACTS IN THE LITERATURE, BEFORE 1910, PERTAINING TO THE SUBJECTS OF URETERAL STRICTURE, STENOSIS, OR OBSTRUCTION

**Autopsy reports** Englisch, reporting in 1879 upon the findings in an unpicked series of 1,200 infant cadavers, established not only the three normal sites of narrowing of the ureter as the pyelo ureteral, iliac, and juxtavesical, but in addition found 65 cases of so called congenital hydronephroses or an autopsy incidence of 5.4 per cent

Of these cases, 34 were due to an accentuation of the normal narrowing at the pyelo-ureteral junction, 28 were due to an accentuation of the normal juxtavesical narrowing, and only 3 were found to be due to a narrowing at a site between these two points

He concluded that the prime etiological factor in hydronephrosis is a *congenitally exaggerated narrowing* of a physiologically narrow site

Schwartz (1896) presented a large collection of cases of hydronephrosis due to *congenital malformation* of all types

Welz in 1903 presented an autopsy report of a case of atresia of the ureter and collected 19 others from the literature. He emphasized the embryonal etiology

Robinson in 1904 presented an autopsy series with drawings of cases of ureteral obstruction and stenoses. This included two cases of peri ureteritis with dilatation and scarring of the ureter secondary to gonorrheal tubo ovarian disease and a case of congenital ureteral stenosis at the bladder entrance with hydronephrosis

Operative reports before 1910 are rare. However, in that year Sternberg presented a specimen of marked left hydro ureteronephrosis due to a very densely stenotic zone 1.5 centimeters long at the juxtavesical region

SUMMARY OF PERTINENT FACTS PERTAINING TO THE SUBJECTS OF URETERAL STRICTURE, STENOSIS, OR OBSTRUCTION IN THE LITERATURE SINCE 1910

This material can be divided into 3 groups: autopsy reports, operative reports, and the large group of clinical reports, with and without pyelographic and wax bulb evidence

**Autopsy reports** The autopsy reports of hydronephrosis secondary to ureteral stricture or stenoses have been many. Isolated case reports coupled with parallel cases from the literature vie in importance with more or less lengthy autopsy series such as that of von Meysen who reported 39 cases collected from the material at Bonn. The more or less comprehensive case reports of Verhoogen and De Graewe, Zimmerman, von Meysen, Wason, Hauser, Gruber and Bing, and Blatt, all emphasize congenital malformation, an embryonal developmental aplasia resulting in atresia, as the prime etiological factor

Hauser suggested maldevelopment or mal-separation of the ureter and vas from their common anlage, the wolffian duct, as an explanation for many cases of juxtavesical atresia of the ureter

**Operative reports** The operative reports have been increasing in number during the past 5 to 10 years

Kahn reported a case of hydro ureteronephrosis with infection in which a water tight valve fold was found in the pelvic ureter

Aschner presented a case in which operation revealed an 'aplastic condition in the upper ureter,' and another in which an almost impassable stricture was found 4 centimeters above the ureteral orifice

Oelsner presented an operative specimen of right hydro ureteronephrosis with infection and with two stricture zones—one at the pyelo ureteral junction which he interpreted as due to aberrant renal vessels, and a second in the iliac region, as etiological factor for which he emphasized a past history of operations for suppurative appendicitis and suppurative right adnexal disease

Anspach reported a case of hydro ureteronephrosis due to a stricture at the juxtavesical region treated successfully by nephropexy and ureteral dilatation. Walther reported a case of calculus apparently secondary to stricture obstruction at the site of the ligamentum latum

Richardson in 1924 presented 3 cases operated upon in each of which a definite stricture was found, one secondary to a traumatic ureterovaginal fistula, the second a case of very dense stricture in the ligamentum latum region and the last a case of bifid ureter with a calculus impacted above a stricture zone in the lower ureter

Perlman gave a comprehensive review of the literature and followed this by a report of 7 cases of ureteral stricture 6 with corroborative operative findings of which 3 were of tuberculous nature

Hunner, in his series of reports, presents many operative cases which will be included in the general summary of his work, to follow shortly



On the other hand Morrissey reports 5 cases operated upon with the pre-operative diagnosis of ureteral stricture in four of which nothing was found and in the fifth an aberrant vessel which was questionably of etiological importance

**Clinical reports** The work of Hunner summarizes for the most part the bulk of these reports In his series of papers from 1911 to 1925 he emphasized the following points relative to ureteral stricture

The incidence is very much greater than it was previously and generally believed to be Hunner's last reports are based on 2 000 personal cases

The importance is great in differential diagnosis not only in diseases of the genitourinary tract but in all obscure abdominal conditions

The cause of predominatingly great importance is an *intrinsic inflammatory process* of the ureteral wall *metastatic* in nature due to focal infection from the teeth tonsils or sinuses The diagnosis is made through the history by the cystoscopic wax bulb hang method and through pyelography The common location is in the ligamentum latum region or at the crossing of the iliac vessels and the condition is usually bilateral Ureteral stricture is an etiological factor in (1) calculus formation and in (2) essential hematuria Latent (symptomless) hydronephrosis is frequently present Recently its importance in relation to obstetrics has been recognized The per ureteral nerve plexuses bear an important relationship to hydronephrotic pain

The mass of clinical reports that have been published during the past 15 years following Hunner's lead have for the most part been presentations of smaller or larger series of cases substantiating his views

Rathbun emphasized not only the high incidence but also intraperitoneal pelvic inflammatory processes as of etiological importance

Herbst and Thompson emphasized extension of inflammatory processes from prostate and seminal vesicles as of etiological importance

Lawes Dabney and Green emphasize its importance in differential diagnosis in obscure abdominal conditions

Baker and Walther emphasize focal infection as of etiological importance The evidence of the former a tabular presentation of oral infection incidence in cases presenting stricture symptoms and signs may be as much coincidental as relative

Turlington and Goldstein presented series of 115 and 23 cases respectively, with pyelographic and wax bulb evidence confirming Hunner's views

Eisendrath has emphasized the anatomical pit falls in diagnosis and Braasch the pyelographic

Caulk presented a case of megaloureter apparently due to obstruction at the ureterovesical region interpreted by him as a 'valve' and treated successfully by intravesical operations

Desnos summarized the entire status of the question of ureteral stricture and emphasized trauma either from stone or operation with secondary infection from the bladder as of prime etiological importance

#### DEFINITION OF TERMS

Before we go farther it is advisable to define specifically several descriptive terms that will be frequently used

The regional zones of the ureter in male and female subjects are shown in Figures 1a and 1b

The gross descriptive term *dense* or *densitv* used in the description of the gross ureteral wall as seen from its mucosal surface after the ureter had been split along its anterior aspect is used to convey the impression that the ureteral wall in a particular region appeared relative to other portions of the ureter as though its tissues were more solid more compact firmer, tougher, less elastic and whiter

This term has been applied usually to narrow stenotic stricture or suspected stricture zones or to entire portions of the ureter such as the postarterial or juxtavesical regions

It is to be emphasized that this is a descriptive term for the *gross* specimen which has been always subsequently checked by histological findings

Varying degrees of density have been expressed through a scale of one plus (+) to three plus (+++)

#### MATERIAL AND METHOD

The observations and conclusions in this report are based upon 4 types of material (1) autopsy material, (2) histological preparations, (3) clinical records, and (4) autopsy records

1 *Autopsy material* The autopsy material consisted of 100 consecutive unpicked autopsies done at the Senkenberg Pathological

Institute, Frankfurt am Main, comprising 42 adult males, ages 22 to 87 years, 37 adult females, ages 20 to 81, and 21 children ages seventh month prenatal to 15 years

The author personally assisted at every autopsy to inspect the peritoneal situs, abdominal and pelvic, and to note all gross findings in each autopsy relative to the subject of ureteral stricture, such as intra peritoneal tumors, glands aberrant vessels old and recent inflammatory processes

The kidneys, ureters, and all pelvic organs in each case were left undisturbed for subsequent examination and dissection After careful examination of these organs *in situ*, the entire pelvic contents, with ureters attached, were dissected free *en masse* retro peritoneally, by cutting through the pelvic diaphragm, anal canal, upper vagina below the cervix, and the urethra The entire mass was then carefully dissected out, particular attention being paid to (1) the course of the ureter, (2) the ligamentum latum with the crossing of the uterine artery over the ureter, (3) the presence of uterine prolapse or cystocele, (4) the course and ureteral relations of the vas deferens, (5) the seminal vesicles and prostate, (6) the iliac and hypogastric vessels and glands, (7) the bladder both from its external and internal surface

In each case, the ureters were catheterized to furnish a rough preliminary estimate of their caliber, and to indicate their course and relation to other structures

The ureters were then split from their vesical orifices to the pelvis along their ventral aspect, with fine probe pointed scissors, the uterine artery or the vas deferens being thus divided in their course *The ureter was then examined carefully for both physiological and pathological zones of narrowing and widening, and changes in density in its wall The pelvic ureter was of prime interest*

The ureter was then measured at its presenting sites of narrowing and widening It was spread out on a hard flat surface to its maximum width at each site before measurements were noted Measurements of width were noted in millimeters, being really the length of the internal (mucosal) circumference All measurements of length were noted

in centimeters and then sites in the ureter were determined in "centimeters up" from the ureteral orifice The length of the pars muralis as well as the "distance up" from the ureteral orifice, of the crossing of the vas deferens or the uterine artery were noted in practically all cases Drawings, notes, and measurements in each case were made at the autopsy table

Sections of ureter were taken in almost all cases for histological examination, as control of gross observations, both positive and negative The entire pelvic ureter from the iliac zone of narrowing down to and including the pars muralis was usually taken with a more or less thick mass of underlying sub ureteral tissue, comprising vas seminal vesicle, fatty connective tissue blood vessels and nerves *This gave, in continuity, various zones of the ureter with the underlying tissue for observation and comparison* When any section was too long, it was split in two and the two parts were then mounted on the same slide The lumbar and pyelo ureteral regions were taken only when indicated for examination or control Specimens for histological examination were immediately placed in formalin after having been spread out on slips of bristol

2 *Histological specimens* These were imbedded in paraffin, *longitudinal sagittal sections made* and stained with three stains, hematoxylin eosin, van Gieson connective tissue muscle, and Weigert elastin The sections were mounted under long cover slips on ordinary object glasses

At this point it would be well to state that all histological slides and observations in this study have been gone over and checked by Dr Karl Plenge, chief of the histological department at the Charite in Berlin, and assistant to Professor Lubarsch at the Pathological Institute in that hospital

The photomicrographs in this article have been prepared by Hugo Hinterberger, instructor in photography at the University of Vienna

3 *Clinical records* The clinical records were examined for (a) history of urinary disturbance, (b) history of focal infection, (c) history of, or relative to, ureteral stricture,

(d) physical findings relative to the urinary tract and (e) physical findings relative to focal infection

4. *Autopsy protocol* The autopsy protocol as prepared by the pathologist who made the complete examination was investigated as to the (a) chief anatomical diagnoses (b) the special anatomical diagnoses that might be relative to a ureteral stricture and (c) the special anatomical findings of focal infection. The teeth tonsils and ethmoid sphenoid and frontal sinuses were especially investigated in every case

#### EXPOSITION OF FINDINGS

In the semi diagrammatic drawings used in this article to illustrate our gross findings the numbers found within the ureter at various sites in its course represent in millimeters the width at this site—after the ureter had been split. The degree of density of the ureteral wall is represented by various tones of gray—unshaded or white meaning soft, suppose less solid.

This investigation in which attention was centered upon the ureters revealed the surprising fact that 26 cases or 26 per cent of our entire series presented some type of ureteral disease. A grouping of these 100 cases into 79 adults and 21 children gives the even more surprising result of a little less than 31 per cent or 25 in a series of 79 unselected consecutive adult autopsies presenting some type of ureteral disease.

These figures serve to emphasize the relative importance of the ureter as compared with other structures.

Before examining any of these cases in detail the entire 26 will be presented in tabular summary.

A. Cases in which the ureteral pathological findings were of *primary origin in the ureter* a total of 5 cases

#### Adult Female—3 Cases

- Case 42 Right pyelo ureteral stenosis with hydronephrosis  
 Case 79 Right pyelo ureteral stenosis with hydronephrosis  
 Case 98 Congenital anomaly. Right complete division of entire ureter with two orifices opening into bladder. Left bifid ureter with hydro uretero nephrosis

#### Adult Male—Cases

- Case 24 Right bifid ureter down to iliac region with hydro ureteronephrosis  
 Case 97 Left juxtavesical stenosis with hydro ureteronephrosis

B. Cases in which the ureteral pathological findings were *secondary* in etiological sequence to a neighboring pathological process a total of 21

#### Adult Female—9 Cases

- Case 58 Bilateral chronic fibrotic pelviceretitis with secondary healed infected hydro uretero nephrosis secondary to old bilateral adnexal disease with pelvic peritonitis retroperitoneal cellulitis and thrombophlebitis  
 Case 74 Bilateral chronic and subacute pelvic ureteritis with secondary pyonephrosis (infected hydro ureteronephrosis) secondary to bilateral chronic and subacute active tubo ovarian abscess with pelvic peritonitis (retroperitoneal cellulitis)  
 Case 18 Stenosis of the ureter in the left ligamentum latum region—secondary to old subureteral scar  
 Case 7 Narrowing of ureter with subureteral scar in left ligamentum latum region (?) secondary to traction of large cyst of the right adnexa  
 Case 85 Marked fibrosis of external half of ureteral wall secondary to chronic ascending lymphangitis of ureteral wall from chronic cystitis  
 Case 30 Subacute ureteritis of lower ureter secondary to cystitis (cystica)  
 Case 20 Kink of right ureter at site of crossing of right uterine artery with right hydro uretero nephrosis secondary to prolapse of uterus  
 Case 94 Marked hypertrophy of external longitudinal muscle bundles of pelvic ureter secondary to prolapse of uterus  
 Case 51 Localized dilatation with scarring or hypertrophy of wall of left postarterial ureter at site of a firmly adherent left ovary

#### Adult Male—10 Cases

- Case 8 Localized stricture in the right juxtavesical region secondary to localized chronic ureteritis secondary to chronic neurological cystitis secondary to old fracture of third lumbar vertebra with transverse traumatic myelitis. Right hydro ureter  
 Case 7 Hypertrophy and dilatation of ureter secondary to prostatic obstruction  
 Case 27 Hypertrophy and dilatation of ureter secondary to prostatic obstruction  
 Case 91 Hypertrophy of muscularis of ureter secondary to prostatic obstruction  
 Case 92 Sclerofibrosis of external half of ureteral wall secondary to prostatic obstruction (hypertrophic or chronic lymphangitis)  
 Case 88 Sclerofibrosis of infravascular portion of ureter secondary to prostatic obstruction (hypertrophic or chronic lymphangitis)

Case 26 Subacute ureteritis of lower 5 centimeters of ureter, secondary to subacute (uræmic?) cystitis

Case 21 *Grossly*—negative *Microscopically*—shows active subacute retroperitoneal cellulitis, secondary to tuberculous peritonitis with mixed infection extending through subureteral fatty tissue into ureter wall

Case 36 *Grossly*—negative *Microscopically*—lymphatic leukæmic (or lymphomatous) foci

Case 96 *Grossly*—negative *Microscopically*—lymphatic leukæmic deposits

#### Children—2 Cases

Case 66 Narrowing of ureter with subureteral fibrosis at site of crossing over lateral umbilical ligament, obliterated hypogastric artery

Case 23 *Grossly*—negative *Microscopically*—lymphatic leukæmic deposits

Added to the above list of 26 cases, there are 2 which we can classify as *borderline* cases between the physiological and that type of definitely pathological, which is exemplified by Case 97, juxtavesical (congenital) stenosis with hydro ureteronephrosis. These 2 cases—numbers 32 and 61, will be discussed more fully later.

It will be seen from this summary that we have found an autopsy incidence of 8 per cent of all types of hydro ureteronephrosis. In every one of these cases, the diagnosis of the hydro ureteronephrosis was made by gross inspection. Indefinite doubtful cases have not been included. In addition to this 8 per cent of definite hydro ureteronephrosis, we have found 5 cases in which the ureters were definitely dilated above an obstruction but without definite gross dilatation of pelvis and calyces making a grand total of 13 per cent autopsy incidence of hydro ureteronephrosis secondary to obstruction.

In these 13 cases of hydro ureteronephrosis due to urinary obstruction, the ureter was the site of obstruction in all except one case, that being one of prostatic hypertrophy without compression stenosis of the ureter by the vas, as described by Tandler and Zuckerkandl. The ureteral obstruction in the 12 other cases was due to narrowing or stenosis in 10, and in irregular dilatation coincident with or secondary to a post inflammatory scarring of the ureteral wall in 2.

Of the 10 cases of stenosis of the ureter with a secondary hydro ureteronephrosis, 5 or 50 per cent (5 per cent of all our cases)

were congenital. Of the remaining 5 cases—2 either were caused by, or were coincident with localized subureteral scarring in the region of the ligamentum latum—2 were due to kinking of the ureter over anatomical structures, in one over the uterine artery, in the other over the vas deferens, and the remaining single case was the only one caused by a chronic fibrotic inflammatory process involving the ureteral wall in such a way as partially to occlude its lumen. However, this localized fibrotic ureteritis (in the juxtavesical region) was definitely secondary to an active and intense acute and chronic cystitis, either through the medium of direct or lymphatic extension. There was not a single case in which the lesion required the hypothesis of blood borne focal infection for its complete explanation.

The details of the above 12 cases of ureteral obstruction follow.

#### CASES OF URETERAL OBSTRUCTION DUE TO STENOTIC NARROWING APPARENTLY OF CONGENITAL ORIGIN (DEFECTIVE EMBRYOLOGICAL DEVELOPMENT)

Case 97 Autopsy 1314 Male, age 27. The clinical diagnosis was acute diffuse peritonitis secondary to ruptured appendix. The history and physical examination were negative both as to the urinary tract and focal infection.

*Postmortem findings* Gross The right kidney and ureter were negative (Fig. 2a). The left kidney and ureter showed marked left hydro ureteronephrosis above the site of obstruction in the juxtavesical region (Fig. 2b). Gall stones and cryptic tonsils were noted as potential foci of infection. *Microscopic* The right ureter was negative, save for acute retroperitoneal (perireteral) cellulitis, secondary to acute diffuse purulent peritonitis extending into the ureteral wall in the form of edema and a moderate infiltration of scattered and densely packed mononuclear cells.

For the condition of the left ureter, see Figures 2c and 2d.

It will be noted that

1 This hydro ureteronephrosis was a clinically latent condition.

2 There was no evidence of recent or past inflammatory process in the left juxtavesical region.

3 The separate, large and distinct oblique muscle masses in this region may have been of etiological importance in the hydro ureteronephrosis, in that they may have

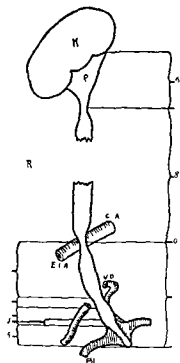


Fig. 1a Anatomical division of the ureter in the male  
 A Kidney P pelvis C I A common iliac artery  
 E I A external iliac artery Bl bladder R right side  
 1 Parietal or prevascular or supraval portion of pelvic ureter  
 2 pars vas deferens 3 pars postvasal or infraval deferens 4 juxtavesical region or chief isthmus (Schewkenemko) 5 pars muralis 6 pelvis 7 pyelo ureteral junction or pyelo ureteral zone of narrowing or upper isthmus or adrenal narrowing 8 lumbar or chief spindle or lumbar enlargement of lumbar ureter 9 iliac narrowing or lower isthmus 10 pelvic ureter 11 ureteral orifice

Microscopically, both right and left ureteral walls presented marked hypertrophy of the muscular coat the individual smooth muscle bundles being increased two to three times in thickness compared with the normal of this patient's age and size

The above 2 cases are prototypes of a common type of low ureteral obstruction. The site of obstruction which is due to kink narrowing of the lumen of the ureter by the uterine artery crossing in the female in the condition of descensus uteri and by the vas deferens crossing in the male in prostatic hypertrophy is found usually between 1 and 5 centimeters up from the ureteral orifice

This condition in the female has been described pathologically by Virchow Zimmer Tandler Halban and Hirokawa and its clinical importance in the more advanced stages has been emphasized by Rubin

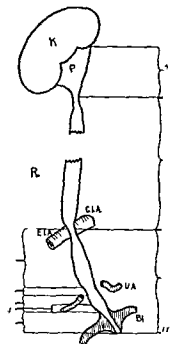


Fig. 1b Anatomical divisions of the ureter in the female  
 A Kidney P pelvis C I A common iliac artery  
 E I A external iliac artery U Uterine artery Bl bladder R right side  
 1 Parietal or pre arterial or supra arterial preligamentous ureter 2 pars arterialis subarterialis or pars ligamentum latum 3 pars postarterial or infra arterialis 4 juxta esical zone or chief isthmus 5 pars muralis 6 pelvis 7 pyelo ureteral junction or pyelo ureteral zone of narrowing or upper isthmus or adrenal narrowing 8 lumbar or chief spindle or lumbar enlargement or lumbar ureter 9 iliac zone of narrowing or lower isthmus 10 pelvic ureter 11 ureteral orifice

The male type has only recently been described and its clinical importance emphasized by Tandler and Zuckerkindl

#### CASES OF URETERAL OBSTRUCTION WITHOUT STENOSIS OR NARROWING DUE TO POST INFLAMMATORY SCARRING OF THE URETERAL WALL

Case 74 Autopsy 1285 Female age 47 The clinical diagnosis was cardiac insufficiency ascites diabetes tertiary lues cystopyelitis the history and physical examination showed kidney infection 6 months before death

Postmortem findings Gross Bilateral suppurative hydronephrosis was present The right and left ureter are shown in Figure 10a A bilateral tubo ovarian abscess mass was overlying the course of the pelvic ureter The tonsils were cryptic

Microscopic findings See Figure 10b

Case 58 Autopsy 1257 Female age 59 The clinical diagnosis was carcinoma of the breast

Bilateral breast amputation for mammary carcinoma had been done. The history and physical examination were negative relative to the genito urinary tract or focal infection.

**Postmortem findings.** Gross. The entire pelvic peritoneal cavity was obliterated, except for a small portion behind the right ligamentum latum, by dense firm peritoneal adhesions binding all pelvic organs into a dense firm mass. Scars were in the pyramids and pelves of both kidneys. The right and left ureters were relatively the same (Fig. 11a).

**Microscopic findings (Figs. 11b and 11c).**

In the above 2 cases, the following points should be emphasized:

- 1 The involvement of the ureter secondary to the adnexal disease was very destructive.
- 2 The intense ureteritis was localized to the pelvic ureter with only very slight inflammatory changes in the ureter above the iliac crossing.

- 3 Secondary dilatation was present above the marked pelvic ureteritis, despite the fact that there was no stenosis. The inflammatory destruction of muscularis and elastica in the pelvic ureter, coupled with the periureteral fibrosis and perhaps the neurological disturbances secondary to the periureteritis very likely caused urinary stasis, with secondary hydro ureteronephrosis by affecting the peristaltic propulsive and expulsive functions of the pelvic ureteral wall.

- 4 Active and fibrotic perineuritis and periganglionitis were very marked. This picture may explain much obscure genito urinary symptomatology.

- 5 There were evidences of healed marked thrombophlebitis of periureteral veins with extension of a periphlebotic process into the ureteral wall.

#### SUMMARY OF FINDINGS IN TWELVE CASES

The finding of the above 12 cases in our unselected 100 consecutive autopsies suggests that the importance and incidence of hydro ureteronephrosis have been generally under estimated, and that Hunner's emphasis of this condition is justified.

From the standpoint of pathogenesis and etiology of hydro ureteronephrosis, I would call attention particularly to the following:

- a Pathological congenital ureteral narrowings, which usually appear as accentuated narrowings of a physiological narrow site, usually

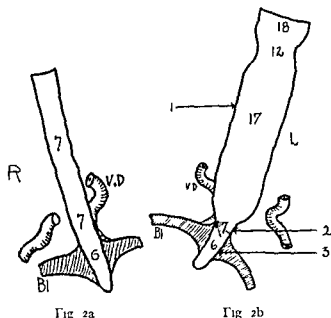


Fig. 2a

Fig. 2b

Fig. 2a Case 9, autopsy No. 1314. Right side negative compare with Figure 2b. Bl Bladder V D vas deferens crossing at 3 centimeters.

Fig. 2b Same case as in Figure 2a. Latent hydro nephrosis without infection. 1 Intire left ureter dilated thickened hypertrophic above 2 the left juxta vesal region. Compare with Figure 2a. 3 Narrow pars muralis 1.8 centimeters long. 4 Vas deferens crossed ureter at 3.5 centimeters. Bl bladder. The left kidney showed marked hydronephrosis with dilated pelvis and calyces and thinning of the parenchyma.

either at the pyelo ureteral junction zone or at the juxta vesical zone.

- b Extension into the ureteral wall of neighboring inflammatory processes, especially adnexal disease in the female and advanced cystitis. In the former, thrombophlebitis of the uterine plexus at the base of the broad ligament, with periphlebitis, is an important factor.

- c The potential kinking power of the two structures that cross the ureter, namely the vas deferens and the uterine artery.

- d The importance of focal infection is not evident.

Hunner's clinical localization of most of his stenotic lesions in the lower pelvic ureter from 2 to 5 centimeters up from the ureteral orifice is substantiated by the pathological findings enumerated.

#### ANATOMICAL CONDITIONS INFLUENCING THE FEELING OF RESISTANCE TO THE WAX BULB

In this investigation, a number of anatomical conditions, both physiological and border line, were encountered, which demand

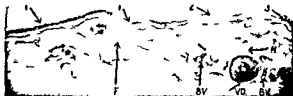


Fig 2c Case 97 Longitudinal sagittal section through left pelvic ureter enlarged. Compare with gross findings Figure 2b and high power photomicrograph Figure 2d 1 Dilated thickened hypertrophic ureter above 2 thickened dense (stenotic) juxtavesical zone (Fig 2d) 3 thin pars muralis 4 subureteral fat edematous 5 D vas deferens 6 blood vessels 7 nerves Patient died from diffuse purulent peritonitis

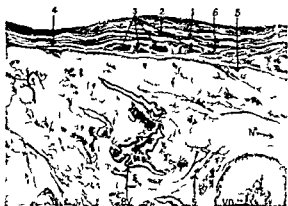


Fig 2d Case 97 Longitudinal sagittal section through stenotic dense left juxtavesical zone enlarged. This localized thickened dense stenotic zone is composed of 1 thick dense longitudinal muscle bundles separated by 2 an excessive amount of thick dense intermuscular connective tissue most marked in the external half of the ureteral wall. This dense connective tissue continues upward gradually thinning to form the adventitial layers of the pelvic ureter 3 diffuse edema of subureteral fat extending into the ureteral wall 4 D vas deferens below juxtavesical region 5 blood vessels 6 nerves with ganglion cells. Note relative to 5 patient died with diffuse purulent peritonitis

explanation especially from the standpoint of the interpretation of wax bulb findings. It is presumed that a hang, or the feeling of resistance on withdrawal is due to a combination of two factors (1) narrowing of the lumen of the ureter and (2) an increase in the density of its wall. The first acting alone could theoretically produce a hang by resisting the passage of the shoulder of the wax

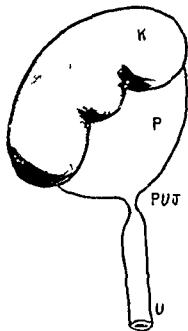


Fig 3a Case 9 Autopsy No 1291 Female aged 73. Latent right hydronephrosis 1 UJ Narrowing at site of right pyelo-ureteral junction with P pyelectasis and A slightly hydronephrotic kidney U normal caliber ureter. No aberrant vessel or periureteral fibrosis is present at stenotic site. Compare with Figure 3b

bulb. The second acting without the first should in theory produce no hang. However, the two acting together theoretically produce the true or pathological hang.

By far the greatest number of ureteral strictures reported diagnosed by the wax bulb method have been found in a region 2 to 5 centimeters up from the ureteral orifice. In this very region however we find the following gross and microscopic physiological anatomical conditions: the juxtavesical zone of narrowing, physiological narrowing of the pars arterialis and pars deferens physio-



Fig 3b Longitudinal sagittal section through right pyelo-ureteral junction Case 9 enlarged 1 thinned dilated pelvic wall—thin muscle bundles few layers 2-4 very thin loose connective tissue 5 pyelo-ureteral junction three to four times thicker than pelvis with entire wall composed of densely packed thick muscle bundles five or six layers running for the most part obliquely with 6 very dense intermuscular connective tissue throughout wall 7 beginning of ureter

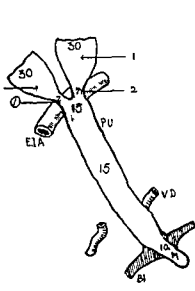


Fig. 4

Fig 4 Case 24 autopsy No 1202 Male aged 47 Congenital anomaly of right ureter Ureter bifidus down to crossing over iliac vessels 11 centimeters up 1 Stenotic and dense junction ends of both upper branches 2 hydro ureters above these two stenotic zones leading to hydro nephrotic kidney *E I A* External iliac artery *P U* parietal ureter *V D* vas deferens crossing at 3 centimeters *M* pars muralis 15 centimeter long *Bl* bladder

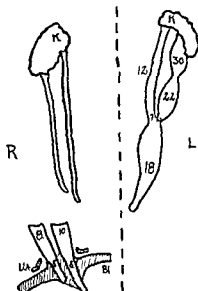


Fig. 5

Fig. 5. Case 98. Autopsy No 1315. Female aged 52. Diagrammatic representation of bilateral congenital anomaly of ureters. There is a complete split of right ureter (so called double ureter) with two ureteral orifices in bladder the upper lateral orifice leading to lower pole and the lower medial orifice leading to the upper pole. The right kidney is atrophic. On the left side there is a bifid

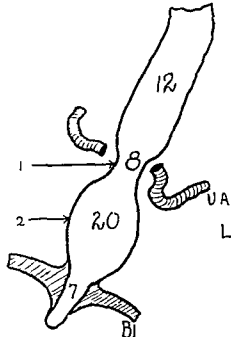


Fig 6a

ureter down to the midpoint of the lumbar ureter 15 centimeters up with hydro ureteronephrosis and hydro-nephrotic shell of kidney

Fig 6a. Case 28 Autopsy No 106 Female aged 64. Adnexal adhesions bilateral ureteral dilatation marked calcification of uterine arteries 1 Dense and narrow zone in left ureter at crossing of uterine artery, 4.5 centimeter-up with dilatation above and below (Compare with Figure 6b) 2 Infra arterial ureter not only dilated to 0 millimeters but also dense and thick. U A Divided uterine artery crossing at 4.5 centimeters. Bl bladder with pars muralis 2 centimeters long

logical narrowing with subureteral fibrosis of that portion of the ureter overlying the obliterated hypogastric artery, and redundant folds of mucous membrane (so called valve formation)

The *juxtavesical zone of narrowing* This was investigated and emphasized by Schewkunenko. The zone varies in length from a few millimeters to 1 or 2 centimeters. Its upper limit is indefinite but its lower limit is bounded anatomically by the proximal or upper limit of the pars muralis. In the adult female, this is found to average 2.2 centimeters up from the ureteral orifice, in the adult male 1.9 centimeters up from the ureteral orifice, in children 1.1 centimeters up from the ureteral orifice, these three measurements being respectively the average length of the pars muralis in these three groups as estimated from our data.

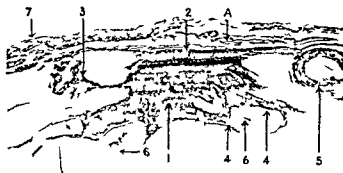


Fig 6b Case 28 Autopsy No 1205 Female aged 64 Longitudinal sagittal section showing 1 localized old dense thick subureteral scar co responding with zone of density and stenosis seen in gross in left ligamentum latum region 45 centimeters up in ureter (Compare with Figure 6a) 2 This scar tissue extends directly into the adventitia of the ureter at this site but apparently not into the muscularis It spreads peripherally 3 perivascularly and 4 between fat lobules intertrabecularly 5 a very markedly sclerotic and calcific blood vessel (vein) can be noted here immediately beneath the ureteral wall 6 nerve 7 ureteral wall in sagittal section 8 artificial space



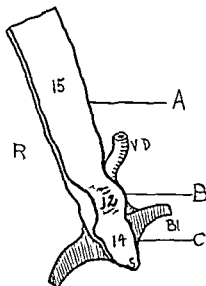


Fig. 1

Fig. 1. Case 5 Autopsy No. 11,2 Male aged 37. Fracture of third lumbar vertebra with secondary (neurological) cystopyelitis. Contracted bladder B. Localized thick firm constricted zone in juxtavesical portion of ureter 4 ureter above this zone oft thin slightly dilated C pars muralis dilated but chronically inflamed 1.5 centimeters long. Compare with microscopic sections through these zones (Fig. 2) 1 D vas deferens Bl bladder Right side

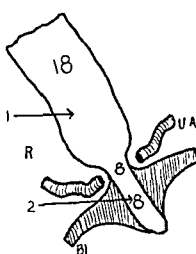


Fig. 2

Fig. 2. Case 20 Autopsy No. 1105 Female aged 66. Descensus uteri 1 Ureter dilated above the crossing of the uterine artery U 1.25 centimeters up in juxtavesical region narrowing at and below this site Bl bladder with pars muralis 2.5 centimeters long. This ureter lead to a moderately hydronephrotic right kidney.

Fig. 3. Case 2 Autopsy No. 1105 Male aged 66. Median lobe prostatic hypertrophy 1 Marked dilatation with thickening of entire ureter above site of crossing of vas deferens 1 D which crossed ureter 3.5 centimeters up in juxtavesical region undilated pars muralis and pars juxtavesical below vas deferens Bl bladder

We cannot substantiate the findings of Schwankunenko that the juxtavesical region is the narrowest portion of the ureter outside of the ureteral orifice. However our findings would indicate the following:

There is a relatively constant narrowing at this site.



Fig. 3

This is usually the site of a more or less gradual tapering down of the relatively wide infra-arterial or infravascular ureter to the relatively narrow pars muralis. The proportion of the former to the latter is on the

Fig. 4. Case 8 Microscopic horizontal sections through zones 4 B and C 1 was taken 2 centimeters above the stenotic zone. The wall is thin and relatively free from inflammatory reaction. No edema, fibrosis, or mononuclear infiltration except in the tunica propria can be seen B Stenotic zone. There is marked thickening of wall active inflammatory process involves the entire wall. The tunica propria shows dense mononuclear infiltration with edema and fibrosis. The muscularis shows marked edema and mononuclear infiltration in the intermuscular connective tissue planes. The adenitis presents a picture of a chronic inflammatory process spread or extending out from the ureter wall into the perireteral fat in the form of edema, fibrosis and mononuclear infiltration C Pars muralis showing chronic inflammation of intermediate intensity between 4 and B. Moderately dense mononuclear infiltration throughout the wall with moderate edema. Process spread only very lightly beyond the outer muscular layer into the perireteral tissues F Perireteral fat U ureteral wall 1 Ureteral wall 2 perireteral fat 3 chronic inflammatory process extending out into perireteral fat 4 ureteral wall

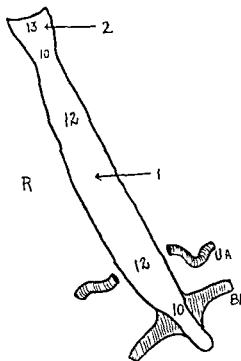


Fig 10a Case 74 Autopsy No 1285 Female aged 47 Bilateral subacute and chronic tubo-ovarian abscess BI lateral pyonephrosis (suppurative hydronephrosis) 1 Thickening with increase in density and slight dilatation of entire pelvic ureter with 2, soft thin lumbar ureter above the iliac narrowing UA uterine artery crossing at 3.5 centimeters BI bladder with difated pars muralis (10 millimeters) centimeters long

average in the female as 11 to 15, or as 3 to 2. In the male the proportion is as 11 to 15 to 6 to 7, or as 3 to 2, while in children, it is as 8 to 15 to 4, or a little less than 2 to 1.

Furthermore, the juxtavesical region presents another constant physiological anatomical attribute which distinguishes it from other portions of the ureter. In the gross, this zone is seen to be the site of a relatively constant increase in density of its wall as compared with all portions of ureter above this site.

My sagittal sections show histologically that this density is caused by a constant change in the histological appearance of the wall of the juxtavesical region as compared with the ureter above. In the juxtavesical region, the muscularis is physiologically two to five times as thick as in the pars parietalis. Furthermore, this muscularis is not only thick, but as a layer, it is found to be composed of very thick and densely packed longitudinal muscle bundles, with very dense and



Fig 10b Case 74 Longitudinal sagittal section through ureter with subureteral tubo-ovarian inflammatory mass enlarged 1 Acutely and chronically inflamed fallopian tube 2 acutely and chronically inflamed ovary with old 3 and recent 26 corpora lutea 3 chronically and acutely inflamed retroperitoneal and subureteral cellular tissue. This process extending to and through the ureteral adventitia into the 4 ureteral wall which is fibrotic scarred oedematous infiltrated with mononuclear cells and intimately embedded in chronically inflamed peri-ureteral scar tissue. The ureteral wall shows many dilated vessels with new vessel formation 5 Remains of periovarian peritoneal cavity 6 Nerve with fibrotic perineuritis 7 artifactual spaces

thick intermuscular fibrous connective tissue bundles. And lastly the tunica propria or submucosa in this region is usually one half as deep as that above and is composed of denser connective tissue. It should be pointed out that in neither the mural nor juxtavesical portion of the ureter are to be seen circularly disposed smooth muscle bundles to warrant the widely accepted conception of a true ureteral sphincter.

The intensity or degree of gross density of the pars juxtavesicalis is directly proportional to the histological thickness and density of the fibromuscular tunica as described above.

The gross and histological characteristics of the juxtavesical region can be well seen in Figures 12, 13, and 14.

Cases 61 and 32, autopsy numbers 1260 and 1210, represented by Figures 13 and 14 respectively, are borderline cases between the physiological, as described above, and that pathological type represented by Case 97 Autopsy 1314, and Figs 2a, 2b, 2c, and 2d.

Case 97 presented a left hydro uretero-nephrosis due to a congenital stenosis of the

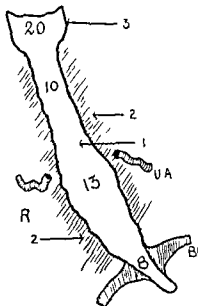


Fig. 11a Case 58 Autopsy No 125, Female aged 59. Bilateral dense pelvic peritoneal adhesions. Lytic scars in both kidneys. Bilateral dilated ureters, pelves and calyces. 1 Irregularly dilated thick dense firm fibrous scarred pelvis ureter bound down in dense firm fibrous (scarred) periureteral (retroperitoneal) tissue. 2 lumbar ureter thin soft dilated to 20 millimeters. 3 Uterine artery crossing at 5 centimeters up Bl bladder with pars muralis. 2.5 centimeters long. Compare with figures 11b and 11c.

ureter at the juxtavesical region. This stenosis was evidently not due to narrowing alone for despite the fact that this region is relatively



Fig. 11b Case 58 Longitudinal sagittal section through right ureter and underlying tissue enlarged. 1 Old organized (fibrotic) thrombus in large vein in juxtavesical sub ureteral tissue. 2 wall of vein with 3 organized (fibrotic) periphlebitis extending directly into 4 ureteral wall. 5 irregular scarring of external half of ureteral wall with complete disappearance or distortion of muscularis in these regions. 6 fibrosis in fat intertrabecular. 7 perineural fibrosis. 8 nerve with ganglion cells. 9 the pars muralis.

narrow compared with the dilated ureter above it was nevertheless no narrower than the same region on the other side which presented no hydro ureteronephrosis. This would warrant the conclusion that the stenosis in this case was due mainly to a dysfunction an unrelaxing sphincter like site which may be secondary to either the histological structural change which is seen as an excessive deposit of fibromuscular tissue at this site or to a deposit of oblique or circular fibromuscular layers instead of the usual longitudinal.

The two borderline cases presented not only an excessively dense fibrosclerotic narrow juxtavesical region in exaggeration of the normal but also a relatively dilated ureter above this site. However in neither was there gross dilatation of either pelvis or calyces which forces them into a borderline group if not into the physiological. In addition Case 61 presented in the left juxtavesical region a distinct thick mass or circularly disposed musculature situated between an inner and an outer muscular layer.

I would emphasize that the ureteral wall in the juxtavesical region resembles that of the more densely fibromuscular vas deferens which at one time in the embryological development of the ureter, formed its "anlage

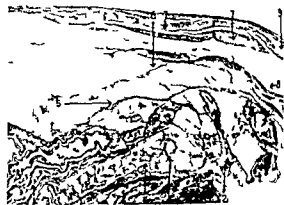


Fig. 11c Case 58 Longitudinal sagittal section through left ureter and underlying tissues enlarged. 1 masses of irregular venous varices with 2a and without 2b thromboses but all presenting marked organized (fibrotic) periphlebitis extending into surrounding fat. 3 masses of dense fibrous tissue which may be primary or secondary to the varices. 4 fibrous (organized) perineuritis. 5 intertrabecular (fatty) fibrosis. 6 fibrosis extending into outer layers of ureter. 7 fibrotic scarred external longitudinal muscular layers. 8 artifactual space. 9 pars muralis.

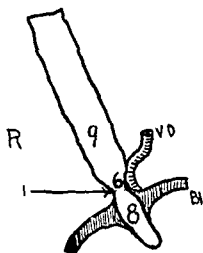


Fig 12a Case 40 Autopsy No 1223 Boy aged 15  
1 Localized zone of narrowing and increased density in juxtavesical region 1.8 centimeters up corresponding with site of crossing of vas deferens 1 D Bl bladder with pars muralis 1.8 centimeters long Compare with Fig ure 12b

as the wolffian duct Hauser reported a case of congenital left hydro ureteronephrosis due to a very marked stenosis in the juxtavesical region, the etiology for which he assigns to a developmental defective separation of the ultimate ureter from its anlage, the wolffian duct or ultimate vas deferens

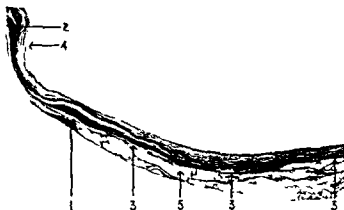


Fig 12b Case 40 Longitudinal sagittal section enlarged 1 very thick dense sharply localized longitudinal muscle mass occupying external half of ureteral wall in juxtavesical region. This mass of muscle is apparently a prolongation upward of 2 bladder musculature (localized hypertrophy or hypoplasia) and it thins as it proceeds upward in the ureter from its point of maximum thickness in juxtavesical region (over vas deferens) 3 prolongation upward of external longitudinal muscle mass from juxtavesical region with gradual thinning to a fine thread like layer in parietal portion of pelvic ureter 4 pars muralis 5 subureteral fat The vas deferens was not included in this section

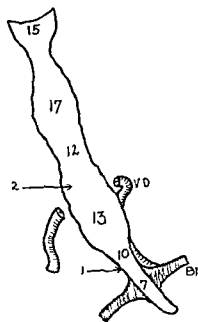


Fig 13a Case 61 Autopsy 1260 Male aged 60  
1 Marked density with slight narrowing in juxtavesical region (Compare with Figure 13b) 2 Slight dilatation with slight increase in density of entire pelvic ureter 1 D vas deferens crossing at 6 centimeters Bl bladder with pars muralis 2 centimeters long

*Physiological narrowing of the pars arterialis* About 10 per cent of the adult female cases presented a zone of slight but definite narrowing of the ureter where it was crossed by the uterine artery. In none of these cases was there subureteral scarring as



Fig 13b Case 61 Longitudinal sagittal section of ureter with underlying tissue enlarged 1 Abrupt increase in thickness of ureter wall as one reaches juxtavesical region Proportion of 4 or 5 to 1 with above This increase of thickness of wall is due to 2 laying on of masses of longitudinal thick smooth muscle bundles with dense intermuscular fibrous tissue apparently continuous with bladder musculature 3 proportion of thickness of musculature in juxtavesical region with that in parietal ureter as 5 or 6 is to 1, 4 gradual thinning out of juxtavesical fibromuscular longitudinal mass as it proceeds upward 5 pars muralis 6 seminal vesicle and 7, vas deferens

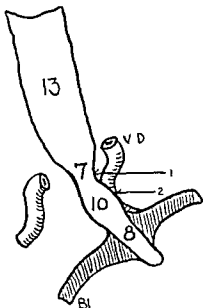


Fig 14a Case 32 Autopsy 1210 Male aged 47 Narrowing and increased density in zone 3.5 centimeters up site of crossing of vas deferens (Compare with Figures 14b and c) dense infravasal (juxtavesical) ureter 1 D vas deferens BI bladder with pars muralis 1.5 centimeters long

in the 2 cases presented above. The site of crossing of the uterine artery varied between 2 and 6 centimeters up from the ureteral orifice.

*Physiological narrowing of the pars vas deferens.* At the site of crossing of the vas

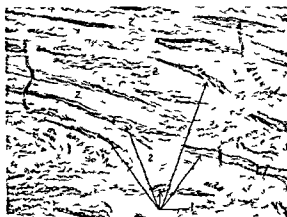


Fig 14c Case 32 High power photomicrograph of dense thick zone overlying vas deferens (Van Gieson stain) 1 Scattered thick longitudinal muscle bundles dense fibrotic sclerotic intermuscular connective tissue laid down in thick bundles



Fig 14b Case 32 Longitudinal section through pelvic ureter with underlying tissues enlarged 1 Markedly thickened and dense zone of ureter overlying vas deferens (tunica propria in this region has been destroyed in the sectioning). The ureteral wall in this region is composed entirely of very dense sclerotic deeply staining fibrous tissue (scar) with thick longitudinal smooth muscle bundles scattered irregularly throughout. No signs of active inflammation are present (See Fig 14c). Below this area merges with a thickened juxtavesical and mural ureter in which the entire wall is composed of regularly arranged but dense longitudinal muscle bundles with very dense intermuscular connective tissue. 3 Above one sees the relatively thin supravasal pelvic ureter in which the wall can be seen to be divided into two zones—4 a lightly staining (tunica propria) loose connective tissue stratum and 5 a densely staining outer two thirds, the tunica muscularis with its intermuscular connective tissue. This layer shows hypertrophy of its muscle bundles with markedly dense intermuscular connective tissue. 6 Vas deferens 7 pelvic peritoneum the parietal portion overlying the ureter. A zone of markedly dense sclerotic fibrotic retroperitoneal tissue is seen in the entire course. 8 Beginning of cul-de-sac of Douglas.

deferens the ureter was found physiologically narrowed in only about 5 per cent of our cases. In one of these cases (Case 32 Autopsy 1210 Figs 14a 14b and 14c) the immediate infravasal and juxtavesical ureter was the site of a remarkable muscular and fibrous tissue hypertrophy and sclerosis.

*Physiological narrowing with subureteral fibrosis* of that portion of the ureter overlying the obliterated hypogastric artery (ligamentum latum umbilicale) was noted in only one case in our entire series of 100 cases (Figs 16a and 16b).

*Redundant folds of mucous membrane—so called valve formation.* Only one case of this type that of a child 2½ years old was found in this entire series (Figs 17a and 17b). It will be noted that the ureter above this valve formation is relatively widened to 12 millimeters as compared with the left 10 millimeters.

A smaller proportion of strictures have been reported in the iliac and pyelo ureteral regions. These two regions however are also zones of congenital physiological narrowing

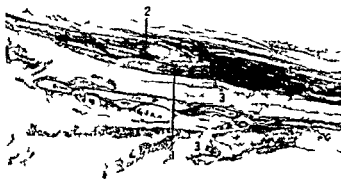


Fig 16a Case 99 Autopsy No 1318 Female aged 31 Longitudinal sagittal section through ureter and underlying tissues at zone of iliac narrowing enlarged (Van Gieson stain) 1 Localized thick dense hypertrophic or hyperplastic external longitudinal smooth muscle mass with deposit of very dense intermuscular fibrous connective tissue 2 perineural fatty tissue 3 fat lobules 4 blood vessels

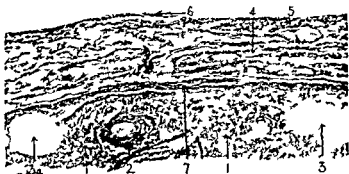


Fig 16b Case 66 Longitudinal sagittal section enlarged (Van Gieson stain) 1 Localized zone of fibrosis in subureteral fat extending directly up to and merging with ureteral adventitia Compare with Figure 16a for corresponding area 2 Perineural fibrosis 3 fat lobules, 4 artifact fat lobule without fatty alveoli 5 muscularis, 6 tunica propria 7 epithelium 7 adventitia

Accurate figures of incidence of these two narrowings cannot be given by us as only exaggerated narrowings were recorded in the first third of our series. However, our impression is that these two zones of narrowing are about equally constant, occurring in about 50 per cent of all cases, the degree of narrowing varying from the frankly physiological to the frankly pathological. We have presented 2 cases (Cases 42 and 79, Autopsies 1226 and 1291) of hydronephrosis due to accentuated

stenotic or pathological narrowing of this physiologically narrow site (Figs 3a and 3b).

We found no case of hydro ureter or hydro-ureteronephrosis which could be ascribed to accentuated narrowing at the iliac site.

However, Case 99, Autopsy 1318, presented a marked physiological narrowing, from 12 millimeters in the pars parietalis to 9 millimeters in the iliac region, 9 centimeters up, plus a localized increase in density in this region. The sagittal section through this

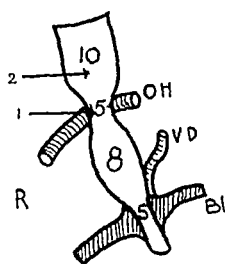


Fig 16a

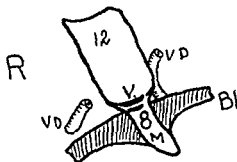


Fig 16b

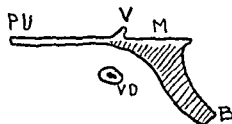


Fig 16c

Fig 16a Case 66 Autopsy No 1271 Boy aged 3 years 1 Narrowed and dense zone in ureter 3 centimeters up at site overlying the obliterated hypogastric artery (this zone narrowing and increased density is shown in detail in Fig 16b) OH or ligamentum latum umbilicale Relative dilatation above this site with no iliac zone of

narrowing. VD Vas deferens crossing at 1.5 centimeters Bl bladder with pars muralis 1 centimeter long Compare with Figure 16b

Fig 17a Case 23 Autopsy No 1201 Child 2½ years old 1 Valve like annular redundant fold of mucous membrane in right juxtavesical region VD vas deferens crossing at 2 centimeters Bl bladder with pars muralis 1.5 centimeters long Ureter thin and soft (?) dilated to 1 millimeters above annular fold

Fig 17b Case 23 Diagrammatic representation of valve like fold of redundant mucous membrane in right juxtavesical region V valve like annular fold juxtavesical region M pars muralis P U parietal ureter VD, vas deferens Bl bladder

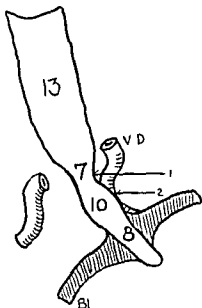


Fig. 14a. Case 32. Autopsy 1210. Male aged 14. 7 Narrowing and increased density in zone 3 5 centimeters up site of crossing of vas deferens (Compare with Figures 14b and c). dense infra-vascular (juxtavesical) ureter. 1 D vas deferens Bl bladder with pars muralis 1.5 centimeters long

in the 2 cases presented above. The site of crossing of the uterine artery varied between 2 and 6 centimeters up from the ureteral orifice.

*Physiological narrowing of the pars vas deferens.* At the site of crossing of the vas

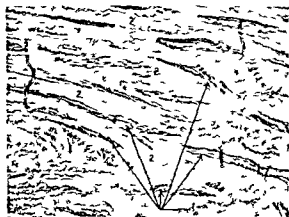


Fig. 14c. Case 32. High power photomicrograph of dense thick zone overlying vas deferens (Van Gieson stain). 1 Scattered thick longitudinal muscle bundles 2 dense fibrotic sclerotic intermuscular connective tissue laid down in thick bundles



Fig. 14b. Case 32. Longitudinal section through pelvic ureter with underlying tissues enlarged. 1 Markedly thickened and dense zone of ureter overlying vas deferens (tunica propria in this region has been destroyed in the sectioning). The ureteral wall in this region is composed entirely of very dense sclerotic deeply staining fibrous tissue (scar) with thick longitudinal smooth muscle bundles scattered irregularly throughout. No signs of active inflammation are present (See Fig. 14c). 2 Below this area merges with a thickened juxtavesical and mural ureter in which the entire wall is composed of regularly arranged but dense longitudinal muscle bundles with very dense intermuscular connective tissue. 3 Above one sees the relatively thin supra-vascular pelvic ureter in which the wall can be seen to be divided into two zones—4 a lightly staining (tunica propria) loose connective tissue stratum and 5 a densely staining outer two-thirds the tunica muscularis with its intermuscular connective tissue. This layer shows hypertrophy of its muscle bundles with markedly dense intermuscular connective tissue. 6 Vas deferens 7 pelvic peritoneum the parietal portion overlying the ureter. A zone of markedly dense sclerotic fibrotic retroperitoneal tissue is seen in the entire course. 8 Beginning of cul-de-sac of Douglas.

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*Redundant folds of mucous membrane—so called valve formation.* Only one case of this type that of a child  $2\frac{1}{2}$  years old, was found in this entire series (Figs 17a and 17b). It will be noted that the ureter above this valve formation is relatively widened to 1 millimeter as compared with the left 10 millimeters.

A smaller proportion of strictures have been reported in the iliac and pyelo-ureteral regions. These two regions however are also zones of congenital physiological narrowing.

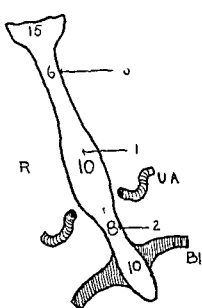


Fig 20a

Fig 20a Case 8 Autopsy 1203 Female aged 77 Thickened contracted bladder marked cystitis 1 Entire pelvic ureter with increased density marked in 2 infra arterial ureter (compare with Figure 20b) 3 iliac narrowing begins at 7 centimeters and ends at 12 centimeters with relatively dilated ureter above U 1 Uterine artery crossing at 5.5 centimeters Bl bladder with pars muralis 3 centimeters long and dilated to 10 millimeters

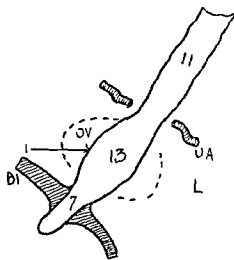


Fig 21

Fig 21 Case 51 Autopsy 1240 Female aged 53 Left ovary adherent to posterior ovary infra arterial ureter 1 Dilated infra arterial ureter with moderate increase in density The ovary was adherent over the subligamentous course of the ureter by dense fibrous adhesions See Figures 22b and c U 1 Uterine artery crossing at 5 centimeters O 1 ovary posteriorly, Bl bladder with pars muralis 2 centimeters long

Fig 22b Case 51 Showing normal right ureter for comparison and control with left ureter Figure 2a U 1 Uterine artery crossing at 5 centimeters, Bl bladder with pars muralis 2 centimeters long

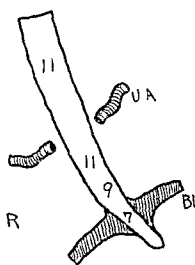


Fig 22b

The involvement of the ureter in an inflammatory process secondary to pelvic peritonitis can be seen in several stages from



Fig 20b Case 8 Longitudinal sagittal section through pelvic ureter enlarged 1 Thick hypertrophic bundles of longitudinal smooth musculature localized for the most part to external half of ureter 2 Very dense deposit of dense thick deeply staining intermuscular connective tissue localized to external half of ureteral wall (fibrosis) 3 Absence of inflammatory process in perireteral connective tissue (not seen well in this section) Fibrosis of external half of ureteral wall was present only in pelvic ureter not above the iliac zone The deposit of dense intermuscular connective tissue in external half of ureter accounts for gross density of ureteral wall observed and is very likely secondary to chronic lymphangitis of ureteral wall secondary to marked chronic cystitis

edema alone to intense residual scarring in Figures 2d, 19b, 11b, 11c Figures 20a and 20b present what is very likely residual scarring of chronic lymphangitis of the pelvic ureter, secondary to chronic cystitis Figure 20b is strong evidence of the anatomical location of the ureteral lymphatics in outer layers of ureteral wall and also of the pathological hypothesis of ascending ureteral wall lymphatic route of infection from bladder to kidney



Fig 21 Case 51 Autopsy 1283 Longitudinal sagittal section of ureter and underlying tissue enlarged Female aged 41 1 Mass of thickened subureteral venous intima with periphlebotic (?) fibrosis 2 ureter wall negative





Fig. 14c Longitudinal section enlarged. From 1 to B localized zone in postarterial ureter corresponding to dilated and dense area seen in gross over which ovary was adherent and in which the wall had finitely increased in thickness and density. If 1 in this area reveal a picture very similar to Figure 14c. This zone is seen to be composed of very dense fibrotic sclerotic connective tissue through which thickened (1) hypertrophic long and short longitudinal smooth muscle bundles are irregularly scattered. This zone tapers down at either end into a thin juxta-vesical region with normal topography and histology and a thin walled supra-arterial ureter 3 also with normal topography and histology. 4 Bladder musculature with 5 pars muralis 6 subureteral fat. Case of mild traction diverticulum formation in the postarterial ureter.

Figure 21 presents a mass of subureteral uterine vein varicosities which underlie a relatively normal ureter. This is presented only to emphasize its potential importance as an etiological factor in ureteral narrowing due to subureteral fibrosis secondary to thrombophlebitis as is seen in Figures 11b, 11c and 6a and 6b. Either subureteral venous varicosities or subureteral venous thromboses or both were found in over 30 per cent of our adult female cases.

Figures 2a and 22c (with Fig. 14b for comparison) present a case of mild traction diverticulum formation in the postarterial ureter due to an ovary adherent over the course of the ureter. What is apparently a mechanical localized work hypertrophy of the wall of the ureter is seen in this region (Fig. 22c).

#### CONCLUSIONS

From the pathological anatomical and clinical data in 100 consecutive autopsies it seems fair to conclude that

1 Structure of the ureter does exist as a definite pathological entity

2 A 12 per cent postmortem incidence of ureteral stricture or stenosis corroborates the great number of ureter strictures or stenoses reported clinically

3 Latent symptomless hydro ureteronephroses due to ureter stricture or stenosis are of relatively frequent occurrence as is evidenced by a postmortem incidence of 10 per cent in our series

4 Ureteral stricture as a localized intrinsic inflammatory process in the ureteral wall metastatic in character due to focal infection apparently either does not occur or is relatively extremely rare as compared with ureteral strictures or stenoses of other origin

5 Ureteral stricture or stenosis is found most frequently in the pelvic ureter in a zone about 2 to 6 centimeters up from the ureteral orifice

6 As prime etiological factors in the pathogenesis of ureteral obstruction due to stricture and stenosis we would emphasize in the order named (a) congenitally accentuated narrowing of a congenital physiologically narrow site (b) extension of inflammatory process into the ureteral wall from adnexal disease with and without thrombophlebitis and advanced chronic cystitis (c) the occluding linking power of crossing anatomical structures namely the vas deferens in the male and the uterine artery in the female

7 Caution is necessary in the interpretation of the physical signs obtained by the wax bulb hanging method of Hunner especially in that very important region 2 to 6 centimeters up from the ureteral orifice for in this region we find numerous physiological sites of narrowing and increased density of the ureteral wall namely (a) the juxta-vesical zone, (b) the iliac zone (c) the ligamentum latum region the site of crossing of the uterine artery (d) the vas deferens region the site of crossing of the vas deferens (e) the site of the obliterated hypogastric artery and (f) the so called 'valve' formation in the juxta-vesical region

The writer takes this opportunity to thank Professor *Ernhard Fischer* director of the *Senckenberg* Pathological Institute and professor of pathology at the University of Frankfurt for the privilege of using this material as well as for the courteous and helpful consideration which this work was invariably accorded. To Professor *Edgar Goldschmidt* professor and assistant director of the laboratory the author's personal thanks are due for his stimulating criticisms as well as for many valuable practical suggestions.

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The recent reports of Hepburn Hugh Snyder and Fletcher could not be obtained

# THE TREATMENT OF OSTEOMYELITIS AND OTHER INFECTED WOUNDS BY DRAINAGE AND REST<sup>1</sup>

By H. WINNITT ORK, M.D., I.A.C.S., LINCOLN, NEBRASKA.

WHEN Sir Joseph Lister undertook to apply the discoveries of Pasteur to surgical practice 50 years ago he had one definite idea. His idea was that if fermenting micro organisms could be excluded from wounds and if their activity could be inhibited by antiseptics putrefaction pyæmia and the long train of wound complications could be avoided. Time and the weight of clinical evidence have proved that he was right. In his own lifetime however Lister departed from the use of carbolic acid and primary antiseptics or asepsis and embarked upon the search for a universal antiseptic. Lister's second choice was boracic acid.

We have sailed on many seas since Lister's time and thousands of other substances and combinations have been employed in the search for the ideal antiseptic.

Since the time of Lister the usual conception of wound treatment has been that infection must be met and defeated by antiseptics. It should be remembered that in infections of all kinds had been successfully overcome long before the time of surgeons or antiseptic. A study of the fossil remains of pre historic animals reveals the presence of healed lesions of bone and joint infections of many kinds. Out of our present day notion as to the importance of antiseptics there have developed certain errors in surgical practice to which I wish to call your attention and for which it is desired to propose a remedy.

In our use of antiseptics there undoubtedly has often been the same misapprehension with regard to cause and effect that obtains and has obtained in the use of other substances used as remedies in other kinds of disease. We have had occasion to try and to abandon hundreds of substances which were at one time relied upon as curative. Now we know that in diseases of many kinds recovery takes place quite regardless of the medicinal agents employed. If we scrutinize the

methods employed in wound treatment we shall have reason to doubt whether it has been generally discovered or recognized that infected wounds do heal without the application of antiseptic agents of any kind.

Before the antiseptic period the usefulness of certain agents in preventing fermentation of all kinds had been demonstrated in many ways.

For the preservation of human bodies after death there had been developed methods over which very little improvement has been made. The control of fermentative processes outside of the body was being given considerable attention although no high degree of perfection was reached until the discoveries of Pasteur. Substances and combinations similar to those used in embalming had been used to a certain extent in the treatment of wounds. They were used for the most part empirically because they seemed to promote healing.

Lanfrank<sup>2</sup> in the 14th century had formulated quite definite and fairly successful methods of dealing with simple and infected wounds. He advocated and employed compresses, sutures and special dressings for wounds of various kinds. He quoted from both Galen and Avicenna to emphasize the point that no attempt must be made to close septic wounds until they had been cleaned up

Lanfrank reports a case in which primary healing occurred and says "I found the wound and the vein all healed and the father and all the neighbors had great wonder."

One encounters the same sort of astonishment whenever patients are seen who are recovering and whose wounds are healing without active antiseptic treatment. It has somehow become a notion prevalent among the laity as well as current in the profession that a certain amount of treatment with poultices, packs, irrigations or antiseptic

T L f k Sc d C g A h m l M S 1306 F l Eng<sup>h</sup>  
t Soc ty Or g s i s 994

powders or pastes is necessary to persuade a wound to heal. The healing of a wound without any of these things is usually looked upon as an interesting and unusual phenomenon. It is the intention of the writer to show that wound healing may be brought about regularly without daily dressings or irrigation with antiseptics, and that there is an easier and better way to promote healing of wounds. The important factors in securing such results are primary asepsis or antiseptics when required, adequate drainage, immobilization of the injured parts, and protection of the wound against disturbance and reinfection.

Since the time of Lister there has developed a disposition on the part of the profession to regard wound treatment as a contest between the germs in the wound and the antiseptic that is being employed. (For severe infections more and stronger antiseptics!) To a certain extent the facts have been lost sight of that on the one hand, with every infected wound there is a certain amount of septæmia against which the patient must battle himself, and which also may become better or worse according to the wound treatment employed, and that, on the other hand, not only may the antiseptic treatment employed be entirely inadequate to cope with the infection, but that it may be more irritating than beneficial to the patient. Moreover, along with the so called antiseptic dressings, additional infection may be introduced into the wound from the air, from soiled dressings or instruments, or from the fingers of the one who is dressing. Many of these points have received too little consideration. Finally, and more important, is the point, that, as a factor in the treatment of any inflamed process, rest has long since been demonstrated to be a therapeutic agent of great importance. Rest for the wound means infrequent dressing, rest for the injured or inflamed part of the body means protection against movement, relief from muscle spasm, relaxation in correct position—that is to say, efficient immobilization.

Dr. Singer<sup>1</sup> in her life of Pare, directs our attention to the methods of wound treatment

worked out by Pare and by his predecessor, Joubert (1570). Joubert was a skilled medical botanist and a learned physician. Toward the end of his life, he employed pure spring water only as his dressing for wounds. Commenting upon this, Pare said: "As for some empiricks who cure simple wounds merely by application of linen, either dry or soaked in water, and sometimes cure them, it is not necessary to believe there is enchantment, or a miracle as do idiots and the populace, but merely in the beneficent action of nature, who cures wounds, ulcers, fractures and other ills. For the surgeon does no more than aid her by removing the hindrance, as pain, flexion, inflammation, and infirmity or other things that cannot be moved by nature alone."

The experience of Pare which led to his simplification of wound treatment is quite generally known. The prevailing treatment for gunshot wounds in his day was cauterization with boiling oil. On one occasion, the supply of oil having been exhausted, he related the following experience: "It chanced on a time, that by reason of the multitude that were hurt, I wanted this Oyle. Now, because there were some few left to be dressed I was forced, that I might seeme to want nothing, and that I might not leave them undrest, to apply a digestive made of the yolk of an egg, oyle of Roses, and Turpentine. I could not sleep all that night, for I was troubled in minde and the dressing of the precedent day (which I judged unfit) troubled my thoughts, and I feared that the next day I should finde them dead, or at the point of death by the poyson of the wound, whom I had not dressed with the scalding oyle. Therefore, I rose early in the morning, I visited the patients and beyond expectation, I found such as I had dressed with the digestive only free from vehemence of pain, to have had good rest, and their wounds were not inflamed, nor tumified but on the contrary the others that were burnt with scalding oyle were feaverish, tormented with much paine, and the parts about their wounds were swollen. When I had many times tried this in divers others, I thought thus much, that neither I nor any other should ever cauterize any wound with Gun Shot."

<sup>1</sup> Singer, Dorothea Waley. Amelrose Pare. London: John Bale Sons & Danclon Ltd. 1924. pp. 62-63.

In discussing the treatment of compound fractures John Hunter,<sup>1</sup> calls attention to the difficulty of combining wound treatment with the maintenance of immobilization. He says: "A variety of inventions have been employed to prevent this motion, but the dressing of the wound every day counteracts the effect of every invention that has been thought of, and it is perhaps impossible to dress the sore without motion." It is interesting to note in this connection that the double inclined plane splint in the form of fracture boxes and a specially constructed bed are suggested in the footnotes by the editor of this edition of Dr. Hunter.

By the work of Hilton<sup>2</sup> (1807-1878) and Thomas<sup>3</sup> (1834-1891) we are taught the control of inflammatory processes by methods designed to conserve body resistance. Hilton and Thomas better than any others have demonstrated the tremendous ability of the body forces to deal with infection. Hilton showed over and over again the value of rest in combating chronic or what we might call low grade infections. He proved that prolonged rest was the therapeutic agent of importance. Following Hilton Thomas was the first to work out a satisfactory method and appliances by which rest could be obtained. With the advent of Pasteur and Lister we had the opportunity which in the mind of the present writer has never been taken advantage of to apply the principle of rest to the treatment of the more acute and more severe infections especially to compound infected wounds of the bones and joints. Lister certainly showed us the way to the prevention and to a certain extent the control of the putrefactive and parasitic processes resulting from the invasion of wounds by septic microorganisms.

It is now proposed to show that by a successful combination of the principles expounded by Lister<sup>4</sup> with those of Hunter

Hilton, and Thomas there can be developed entirely adequate methods for dealing with wounds and wound infections.

What has happened in recent practice is that to a large extent the value of rest in its best sense has been forgotten. Listerism has been construed to demand active chemical antiseptic treatment of wounds. The greatest possible confusion has prevailed as to the methods by which chemical antiseptics is to be obtained.

Keyes, in 1902<sup>5</sup> was endeavoring to compromise the various methods that had been proposed. Speaking of compound fractures, he said for example: "The splint should be applied to the limb before the patient leaves the operating table. If the wound is expected to run a clean course a fenestrated plaster encasement is best reinforced if necessary by iron bands. If however suppuration is feared and daily dressings are expected such a splint soon becomes soiled and soaked with discharge from the wound in spite of every precaution."

"The treatment of wounds is of the greatest importance while the primary irrigation and antiseptics are chiefly to be depended upon to prevent infection. The irritation as well as the danger of infection from the frequent change of dressings is a common cause of the late suppuration." Keyes concludes however in the manner common to the practice of the present time with the following:

"If the wound is but loosely sutured and lightly packed in the first place it may some times be left undisturbed until the fourth day. If at the first dressing the wound is clean it should be disturbed as little as possible. Some of the drainage may be removed. The wound should not be irrigated. After this the dressing is renewed at intervals of from forty eight to seventy two hours until the wound is healed. If active suppuration occurs it must be combated by the usual antiseptic methods."

"If drainage has been used the wound should be dressed at the end of twenty four to forty eight hours, and the gauze or tubes removed."

The appearance of infection in a wound demands the establishment of free drainage.

<sup>1</sup>Hunter J. h. W. k. f. by J. me. F. P. lmer. Ph. l. d. lph. H. ell. B. ngto. & l. l. well. 184.

<sup>2</sup>Hilton J. h. Rest. d. P. n. W. H. A. J. b. 5th. d. pp. 514. A. Bell & S. 1867.

<sup>3</sup>Thomas H. h. Ow. n. Diseased J. i. s. Part II. f. C. tr. b. t. s. t. Med. & S. 6th. 15. 883. Fract. s. a. d. Disloc. t. on. P. t. l. v. J. & P. H. & L. w. C. 1886.

<sup>4</sup>Lister S. Jos. ph. On th. Eff. ts. f. th. A. t. sept. Tr. im. nt. up. the. s. l. ub. ty. of. a. Surg. c. l. Hosp. t. l. 187. and A. C. nt. b. t. nt. th. Ge. m. Theory. of. Putref. on. d. oth. Fern. ntat. e. Ch. nges. 1875.

<sup>5</sup>Keyes Edw. L. J. Fr. ct. Wood. R. f. H. d. B. k. f. th. M. d. l. b. ce. 1902.

and the use of antiseptic irrigation The application of a hot moist antiseptic dressing will often prove beneficial<sup>1</sup>

The above paragraphs represent the tendencies of wound treatment as carried out by most physicians and surgeons at the present time Even a clean wound is scarcely permitted to rest and if infection supervenes or exists at the beginning, all considerations of splinting or immobilization (rest) are cast to the winds in the interest of irrigation packs, etc

Since the writer began the study of methods and results in the treatment of wounds he has found it extremely difficult to arrive at any definite opinion or to obtain definite opinions from others in regard to results of treatment There are thousands of published articles reporting satisfactory results with this method or that in the antiseptic treatment of wounds, but, as statistics are sought with regard to final results with reference to deformity or disability following osteomyelitis, infected fractures or suppurative joints they are extremely difficult to obtain Patients are almost invariably discharged from hospital and even from treatment before they are healed, and the final healing with the amount of disability that results, is something for which we can obtain no statistics in ordinary surgical and hospital practice

At the time of the military draft in 1917 out of the first million and a half men examined, an astonishing amount of disability in the extremities as the result of ununited and mal united fractures and infections of the bones and joints, was found Forty five thousand men, or 2 per cent of all those examined, were found to be seriously disabled on account of these conditions In the Surgeon General's report the causes were said to be "the liability to accident to which young men are subject often in localities where a good surgeon's attendance cannot be secured" However, the percentage of disability for urban and rural cases does not differ as widely as might be inferred from the above comment It was found, in fact, that with respect to mal union of fractures, a condition in which a decided percentage in

favor of cities might be expected no such difference developed For ankylosis of joints following injury and disease, the comparative percentages are also interesting

	Urban	Rural
Mal union of fractures—upper extremity	1 5	1 6
Mal union of fractures—lower extremity	2 2	2 7
Ankylosis of joints	3 2	3 5

Other observations by the writer seem to bear out the general conclusion that differences in disability following fractures and the treatment of other bone and joint wounds do not arise from differences in skill between individuals or groups in the medical profession but that the shortcomings in treatment which lead to disability are common to the profession as a whole These faults as revealed by the present investigation are several, first, the tendency to pay earliest and principal attention to the antiseptic treatment of wounds by pads, packs, irrigations, and the like, and second, to neglect those fundamentals essential to obtaining and maintaining correct length, position, and rest for the injured and infected parts

Listerism as applied to the performance of aseptic operations, has been perfected and improved to a remarkable degree But Listerism as applied to the treatment of infected wounds in general practice nowadays, is scarcely as good as in the days of Lister himself It must be understood that Lister conceived of antiseptics as a means of preventing rather than controlling putrefaction "for it is hardly needful to point out that neither the spray nor the carbolic acid applied externally, nor the oiled lint inserted in the outlet to serve as a drain could correct putrefactive fermentation once established in the abscess cavity Here, as in the antiseptic treatment generally the means are calculated to prevent, not to correct, putrefaction"

Primary asepsis and the protection of the wound for which Lister contended so valiantly, have been to a large extent forgotten in the restless quest for a method or agent which would do what no agent so far has ever done, namely, sterilize an infected wound without damaging the patient

<sup>1</sup> Italics by the writer of the present article

<sup>2</sup> Lister Sir Joseph On recent improvements in the details of antiseptic surgery Lancet London 1875 March 20 p 402

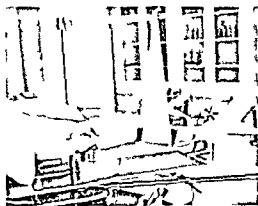


Fig. 1. Case I. II. Condition of patient upon arrival at the hospital. Daily antiseptic dressings for several months. Sequestra inadequate drainage, etc.

Listerism properly understood and properly applied has conferred countless benefits upon surgical patients and has enabled the surgeon to go far with his operative methods and his surgical technique. Listerism misunderstood and badly applied has on the other hand inflicted an immense amount of suffering upon patients with infections and has been responsible for deformity and disability that could have been prevented by less strenuous and more thoughtful treatment.

The following case report (McNamara) is fairly typical of what happens to children with severe acute osteomyelitis. Different writers have given the mortality as from 20 to 50 per cent in such cases. Radical drainage is commonly advised against. It is the opinion of the writer that with the plan of treatment to be described later the results should be just as good as in acute appendicitis. Early drainage is adequate drainage and rest are necessary.

M. A. D. aged 10, admitted in the hospital on January 20. The child's mother states that 10 days ago the patient came from school saying she had fallen and hurt her foot. She limped from this time but until January 22 was able to move about. She was then seated in her chair, seized with a violent fit of shivering. The shivering lasted for an hour or so and recurred again in the evening. During the night the child became delirious. On the 25th she was admitted to the medical ward of the Westminster Hospital as a case of acute rheumatism. On the following day I was requested to see the child in consequence of the inflamed condi-

tion of the left ankle joint. I found the patient bundled up in bed with her knees and thighs flexed. She had the piercing scream of a child suffering from meningitis. Her pupils were contracted, her features drawn almost convulsed, she could not bear the light. The slightest effort to move any of the patient's limbs greatly increased her agony. There were numerous small hemorrhagic vesicles over the skin covering her chest and abdomen. The patient's temperature varied from 103 to 105 degrees. Her lungs were seriously implicated. On examining the left ankle I found a swollen condition of the soft structure over the outer malleolus extending upward some 2 inches along the shaft of the bone. On passing a grooved needle into the part pus exuded along the instrument and I therefore made a free incision down to the bone which was bare of periosteum and the lower end of the diaphysis was necrosed and separated from the epiphysis. The patient's constant piercing cry was so distressing that she was removed to a special ward. But in spite of the careful nursing and treatment she died within a few days.

On making a postmortem examination we found the fibula necrosed and denuded of periosteum for some inches from its inferior extremity which was separated from the epiphysis. On section the cancellous tissue of the bone was found to be inflamed with a number of small abscesses extending upward along the interior shaft of the bone. On opening the right and left hip joints the left shoulder the sternoclavicular and the metacarpophalangeal joint of the left little finger we found the synovial membranes extended with pus. The other joints were not opened. On examining the brain we discovered the membranes to be deeply injected with blood extravasated into the cortical substance of the brain. In the lungs numerous foci of suppuration were observed and similar infections were found in the lining membrane of the right side of the heart.

The points which require emphasis in commenting on an experience like the above are that adequate drainage, antiseptics and rest have apparently all been neglected. A surgical opening of sufficient size and extent to drain the primary focus in any bone infection is the first indication. In such a case as this, metaphyseal or medullary drainage of the first bone infected is definitely indicated. An attempt to reduce the amount of local infection at the time of operation by a fairly powerful antiseptic is the obvious next step. At that point the teachings of Lister and Thomas may be applied. The primary dressing should be such a one as to prevent further invasion of the wound by septic organisms, and there should be applied suitable mechanical



Fig 2

Fig 2 Case 1 Cavity remaining after removal of sequestra & ulceration or effacement of diseased area

Fig 3

Fig 3 Case 1 Entire cavity—bone and soft parts—being packed widely open with vaseline gauze

Fig 4

Fig 4 Case 1 Cavity and entire wound packed open with vaseline gauze No stitches are employed

Fig 5

Fig 5 Case 1 Final covering with vaseline gauze This is covered in turn with an absorbent cotton dressing

devices to put the diseased parts and the patient at rest

Repeated experiences have confirmed the original observations of the writer that such treatment is just as beneficial in acute infections of bone, whether in primary osteomyelitis or in secondary infections following injuries as Hilton and Thomas found them to be in the chronic infective diseases of bones and joints with which they report to us so extensive an experience

In regard to the method of drainage or the type of operation to be employed, it is believed that in the early and very acute cases the simple opening (nearly always through the bone) into the abscess cavity is all that is necessary. The surgical opening however must be kept wide open, drainage through a tube or leakage between sutures is insufficient

McNamara concludes his discussion as follows: "Patients I am persuaded, have died from not having the inflamed tissues sufficiently incised, but I doubt if a child has ever lost his life in a case of this kind, from the surgeon having made too free use of the knife"—a sentiment with which the author of this paper heartily agrees. In fact it is believed that we should go further and say that not only the knife but the chisel should be used more freely in these cases since the common error of the time is to neglect to

provide the medullary drainage which is always required

Starr,<sup>1</sup> of Toronto, has obtained some brilliant results in the treatment of early cases by making drill holes into the ends of the diaphysis and into the epiphysis. This is better than the treatment previously employed because in similar cases previously no drainage whatever had been provided so early for the interior of the bone. It is of course a fact, that in very early stages, by making an opening through the periosteum with drill holes into the bone, with drainage and immobilization a considerable number of these patients will be relieved. The author contends however, that a larger window into the bone with the wound packed wide open and with adequate immobilization will provide better drainage, can be done as quickly with no more harm to the patient, and will most certainly arrest the progress of the infection

Ochsner in an address before the Utah Medical Society states "Primary operation should consist of splitting the periosteum to and above and below the painful area and lifting 1 to 2 centimeters on each side, as a rule this should be the extent of primary operation. Hot moist dressings with electric light treatment hasten recovery"

<sup>1</sup>Starr Clarence The treatment of compound fractures of long bones Illinois M Soc 1924 June

<sup>2</sup>Ochsner A J Acute hematogenous osteomyelitis Arch Surg 1922 May California St J M 1924 xxii 3





Fig. 6 (left). Case 1. Plaster of Paris cast applied to entire limb. In children and some adults, a spica or even a double spica is employed.

Fig. 7. Case 1. Position of patient with leg cast in bed. When a double spica is employed the foot of the bed is raised and 5 to 10 pound traction applied to the cross bar.

Dr. C. C. Chatterton of St. Paul says: "Most dressing hypochlorite, normal saline or boracic acid may be used as aids to drainage but discontinued upon any signs of maceration of the skin. A small catheter may be introduced in the opening and Dakin's method used or tidal wave irrigation with various antiseptic fluids introduced but hospitalization is necessary in this type of treatment. As I shall show you in a moment I think this is wrong. Finally Dr. Dean Lewis refers to this kind of case as follows: 'In the acute cases in which subperiosteal abscess has formed I believe that drainage of the abscess is first indicated. If the fever does not subside and the general condition improve or there is definite evidence of a suppurative process in the marrow the cortical bone should be removed and the marrow cavity drained.'

Delay in providing adequate drainage for the infected bone areas is a common defect in the treatment of osteomyelitis. The teaching has been prevalent that the bone is not to be opened until sufficient involucrum has formed to give strength to the diseased extremity and until complete sequestrum formation has occurred. There is a certain period in the progress of an osteo-

myelitis when the advice to wait for this condition to come about may be correct. Too often however this counsel has been adhered to for many weeks when the patient suffers during the whole period for lack of drainage.

It is contended that many of the poor results and much of the confusion in regard to present methods is due to a failure to relate and combine the well known principles of aseptic drainage, antiseptics (at the proper time) and rest.

Tons of anti-septic chemicals and oceans of anti-septic solutions were employed during the Great War for the treatment of wounds. Most of the wounds would have healed without the application of any anti-septic whatever. During the War we employed too too limited an extent and too ineffectually the one therapeutic agent that is absolutely essential—I refer to rest. It is upon rest that the human body depends to a large extent for its ability to withstand and to resist the secondary effects of injury and infection. In open wounds this rest must include not only the relaxation and support of the injured part as a whole but protection and relief from irritation for the open wound that has been exposed to invasion by micro-organisms. No amount of flooding with anti-septics or of sterilization by irritating solution will compensate for continuous disturbance of the



Fig 8



Fig 9

Fig 8 Case 2 T T Showing condition of leg and knee motion at end of one year Very extreme case

Fig 9 Case 3 I M Showing bone defect and healed wound in the ordinary acute case—at the end of six months—about six dressings in all In cast about 3 months



Fig 10



Fig 11

Fig 10 Case 4 End result of compound fracture in the lower third of the leg at end of 1 months

Fig 11 Case 4 R H Lateral view of patient shown in Figure 10

open wound and irritating motion of a compound fracture. Primary cleansing, free drainage, and absolute immobilization are necessary to approximate ideal treatment.

Secondarily, we must have protection of the wound against reinfection and a continuous relaxation of the diseased part until healing occurs. It was in an effort to find a combination of factors in treatment that would approximate this ideal that the author was led some years ago to discard practically all of the accepted methods of antiseptic wound treatment in an effort to provide rest for the injured part and subsequent protection for the wound. To summarize: The propositions upon which the treatment of wounds by drainage and rest was worked out are as follows:

- 1 Primary asepsis or antiseptics to reduce the focal infection (at the point of acute disease or injury). It is not attempted to remove all infection or all diseased tissue. The patient is relied upon to take care of a part of his infection if he is properly assisted and protected.

- 2 Adequate drainage (wide open to the depths of the infected area).

- 3 A postoperative dressing or method that will protect the wound and the injured or

diseased part so that the wound and the part are at rest and there is no opportunity for reinfection.

- 4 Immobilize (not simply apply a splint) so that movement, pain and muscle spasm are entirely relieved, and with all the parts in correct position for recovery with a minimum of deformity and disability.

One of the lessons of the Great War was that most of the splints in common use served perhaps to handicap the patient's movements to some extent, but to immobilize very little or not at all. Moreover, splinting in nearly all cases was made secondary to wound treatment, and splints were disturbed (and are being today) upon the slightest provocation for wound treatment. My experience during the war and since has been similar to that of Osgood,<sup>1</sup> who says "Plaster of Paris dressings with wide openings bridged by hoops of metal or plaster offers the most perfect fixation and greatest comfort to the patient. These are employed in specially difficult and painful cases. Their disadvantages in an English general evacuating hospital, where there are often periods of great rush are their time consuming initial application and the practical certainty that

<sup>1</sup>Osgood R B. *Am J Orth Surg* 1917 xv 668



Fig 12

Fig 12 Case 5 W C Osteomyelitis Non union 2 years after a simple fracture of the humerus Five operations

Fig 13

Fig 13 Case 5 Six months after Figure 12 Two operations 5 dressings 3 casts body and arm cast shoulder pica employed

*they will be removed when they reach the home hospital*

The lack of attention to splinting for immobilization and the preservation of correct position in these cases is frequently emphasized by demands on the part of patients that some protection be afforded for unstable and deforming extremities. The following quotation from a letter from one of the young officers following his return from France is typical of many similar complaints that have been made. He says: "The half cast placed on the left leg in France was removed upon my arrival in the United States. I asked that the splints be resumed during the following months as I believed I could feel the foot drawing out of shape. However no splint or brace was ever used until after I began to walk when a plate under the foot with braces up the leg was used to take the weight off the foot. A modification of this brace was kept on until the date of discharge when it was removed. I have had no treatment since discharged. I limp slightly and do not know whether the leg is shorter or not, I think it is

At times I cannot place any weight on the foot. The leg is undeveloped it is a very weak sister.

In the interval between the time of Lister and the Great War the treatment of infected wounds had if anything become a little worse rather than a little better. The frantic search for new antiseptic agents left the surgeons confused and uncertain in fact almost panicky when confronted by a large infected wound. The results when we were faced with the situations that developed during the early months of the War were what might have been expected. There was no uniformity either in the matter of antiseptics or methods of application there was little or no splinting and except for early and industrious use of such agents as we had the result would have been much worse than it was.

This is one of the reasons why debridement and the 'let alone' policy advocated by the French made such a striking impression there were a lot of good results. If the same principles had been applied to the wounds

that were left open that were applied to those which it was found possible to close (the principle for which the writer is now contending) the results would have been better still

Primary asepsis and early protection as taught by Lister, continued protection and rest for the wound and the injured part as taught by Thomas, are the two outstanding methods necessary to secure results and these received their vindication during the War

The attitude of the writer toward these questions began to change during his experience in Great Britain and France in 1917-18. This is indicated by the following circular which he prepared in November, 1918. This was distributed with the approval of the commanding officer of the Savenay Hospital Center and the commanding officers of hospitals at Angers, Nantes and St Nazaire, to all ward surgeons. Additional copies were also prepared at the request of Colonel Goldthwaite and sent to other hospitals. This circular in itself tells so much about the orthopedic side of the surgery in Base Hospitals that it is quoted as follows

Hq Hospital Center,  
Savenay,  
28 November 1918

MEMO NO 178

The following is published for the information and guidance of all concerned

By direction of

W E Cooper,  
Lt Col, M C, Commanding Officer  
C S Adams,  
1st Lt San Cps, Adjutant

#### INTRODUCTORY

Certain data and conclusions resulting from a study of several thousand orthopedic cases at Savenay are submitted herewith as suggestions to the surgical services and the surgeons of this area. This information has been collected at the request of the Consultant in Orthopedic Surgery (H Winnett Orr Major, M C USA)

The conclusions reached have been concurred in by the officers whose names are attached (Major Philip D Wilson and Capt Leroy C Abbott). It is believed that the safety and comfort of patients being prepared for and sent on convoys to the United States would be materially improved by an observance of the suggestions following



Fig 14 R S, Case 6 Condition of patient in January, 1927. Soundly healed and has remained so

#### THE TREATMENT OF ORTHOPEDIC PATIENTS IN BASE HOSPITALS

The considerations involved in the treatment of war wounds in Base Hospitals must be made to include not only the existing and imminent surgical pathology but the ultimate position and function of the injured parts as well. It is these latter points which in both civil and military surgery operators have been prone to overlook. A bleeding or infected wound especially if of considerable size, makes an immediate and urgent demand upon the surgeon's attention. There has been a tremendous accumulation of evidence in this war to prove, however, that wounds of whatever size and character heal better if all the parts involved are restored immediately to and adequately maintained in as nearly as possible normal anatomical relations. The different effects of such treatment upon the patient's ultimate career should be almost too obvious to require comment. It is a fact, however, that not only because of the stress of war conditions, but because of the failure of surgeons to interest themselves in what for convenience must be called the orthopedic viewpoint, many of these patients in Base Hospitals for treatment or in preparation for conveyance to the United States have not been dealt with adequately in this regard.

The long discussion over the relative merits of motion traction with motion traction in bed ambulatory traction immobilization without traction etc fairly indicates the state of mind that has continued with regard to plating plaster casts and methods of immobilization of all kinds. Hilton Thomas Kidron and other sound orthopedic surgeons have never been afraid of rest—in bed or in splints. It is inflammation and the effects of inflammation that are to be feared. All of the immediate and remote effects of immobilization (if properly done) are to be seen in the relief of pain the reduction of inflammation the prevention of muscle spasm and deformity and lessening of ultimate disability (ankylosis contractures etc).

Inflammation on the other hand if not prevented or controlled leads inevitably to the adhesion of muscular and tendinous structures erosion of articular surfaces and fibrous and bony ankylosis.

When long continued inflammation has raged in the tissues of a joint deforming the articular surfaces and locking them up in organized lymph and shortened ligaments we have ankylosis the ultimate degree of which will depend in my opinion on the promptness and success of our efforts to arrest the inflammation. And I think that we are wrong when we fear adding to the amount of ultimate ankylosis by early and thorough fixation of the joint. To me it seems reasonable that such a course will diminish the resulting ankylosis by subduing the inflammation and preventing an excess of its products also.<sup>1</sup>

Kidron was one of the earliest and most intelligent exponents of the importance of rest in the treatment of tuberculous joint disease. All of his arguments apply with equal force to the control of motion the relief of muscle spasm and the arrest of inflammatory processes in the treatment of infected wounds. This is particularly true in joint wounds or in those bone and soft part infections that lie in the vicinity of joints. Many experiences in the treatment of severe

infections both acute and chronic in the neighborhood of the hip and knee have convinced the author that complete immobilization of the parts (double plaster spica) is of the greatest importance in securing recovery for such conditions. Adequate fixation of an acute suppurating knee or hip joint in a well fitting double plaster spica will not only afford immediate relief to the patient in the matter of pain but it will turn the tide against the spread of infection septicæmia etc and in favor of the patient. Drainage is of course usually important or necessary but immobilization is absolutely indispensable to a rapid and comfortable convalescence.

The author's method for the treatment of osteomyelitis may be illustrated by an account of a typical case.

Mr. F. nurse age 31. This patient developed an acute inflammatory condition in the left foot in January 1923. The foot was immediately incised but local and general sepsis progressed. Further incisions were made in all parts of the foot and leg following the tendon sheaths and fascial compartments as a customary in such cases. I saw her at the end of the seventh week. She was in serious condition with an enormous swollen leg which had been freely incised and continuously fomented or irrigated for weeks. She had marked hip knee and ankle contracture deformity. The foot and leg were badly macerated and very foul because he would not tolerate any cleaning up measures. A ray at this time showed a destructive bone lesion involving the tarsus which had apparently never been drained. (It may be mentioned that at this time the pain was so severe that she was receiving 1/4 grain of morphine every four hours.)

Upon my advice she was taken at once to the operating room and a thorough drainage operation into the tarsus was done. A good sized abscess cavity was found and cleaned out. The wound was packed well open with a saline gauze and then the hip and knee were straightened out. With a little force the foot was brought up to a right angle with the leg. All of the other open incisions were merely wiped off (or out) with iodine and rinsed with alcohol. A sterile sheet cotton bandage was put on over the gauze dressing and a long cast put on. The patient was put to bed with the leg in suspension and traction. For the first day or two he still clamored for morphine but received none after the third day. At the urgent request of her previous surgeon I did a dressing on the tenth day. There was no discharge and the wound looked healthy. None of the other incisions gave the slightest trouble. This patient was in a cast for 3 months. Then a posterior iron was put on. The wound was entirely healed and has remained so. There is a

little equinus and varus deformity but with a special shoe no disability whatever. For the past two and one half years she reports that she is able to do as much on her feet as she ever did.

The earlier cases treated by the method of drainage and rest did so well, the care of the patients became so much easier and the end results were so satisfactory that as time went on we were able to go further and further in lengthening the periods of immobilization and non disturbance of the wound. Not only have very serious wounds healed without much treatment, but highly septic patients have recovered when recovery was not to be expected with ordinary treatment. Distribution of sepsis has certainly been reduced and body resistance to infection has certainly been fortified by this policy of what might be called "extreme rest." Patients with extensive contracture deformities due to muscle spasm have been put at rest in a few hours by very extensive inclusion of the body and the extremities in plaster of Paris. The treatment of the wound both as to primary operation and as to secondary care has been reduced to almost nothing on the proposition that drainage and rest are the only factors of any particular importance. The exact technique worked out during the years immediately following the War was as follows. (See illustrations for Case 1.)

- 1 Make a fairly large incision over the infected bone area. Spread apart the skin, muscles, fasciæ, and periosteum just far enough to afford access to the diseased area and no farther.

- 2 Chisel a window into the affected bone area large enough so that all diseased bone may be removed and so that there are no overhanging edges of bone over the diseased area. (Less extensive in acute cases.)

- 3 Clean out the diseased area gently with a curette or gouge, being careful to refrain from unnecessarily damaging the tissues undergoing repair.

- 4 Dry the wound and wipe out with 10 per cent iodine followed by 95 per cent alcohol.

- 5 Pack the entire wound wide open but not tightly with a sterile petrolatum gauze pack. Cover this with a dry sterile pad and bandage on.

- 6 Now perform any reasonable forcible manipulation necessary to place the parts in correct anatomical position for splinting (abduct the arm to 90 degrees in humerus cases, dorsiflex and supinate the hand in forearm and wrist cases, dorsiflex the foot to a right angle with the leg, in leg and foot cases, etc.)

- 7 Apply a plaster cast (preferably) or a suitable splint so that the parts are thoroughly immobilized in comfortable and correct position (additional weight and pulley traction, Balkan frame, or even ice tongs or bone pins may be used in these infected bone lesions associated with fractures and old fracture deformities which are being corrected at the same time as the clean up operation.) It may be said that it is in the latter cases that some of the most gratifying results may be obtained by this method.

- 8 Finally, the cast is not to be split nor are windows to be cut in the cast until the wound dressing becomes necessary. And the wound is not to be dressed at all unless there is a rise of temperature or other signs of acute sepsis. As a rule, no dressing is necessary except on account of odor, and this may not be required for several weeks. In a majority of cases the patient treated by this method will go through to complete healing with a few dressings at intervals of from 10 days to 4 weeks.

It may be said that the claims for superiority of the method proposed by the author rest upon empirical rather than upon scientific grounds. There is a lack of the chemical, bacteriological, and statistical evidence commonly adduced in support of contentions of this sort.

In the words of Flexner,<sup>1</sup> however, "There is a widespread impression that the scientific quality of medical practice is in some fashion dependent upon the part played by the laboratory. This is not the case. Science is essentially a matter of observation, inference, verification, generalization.

In considering the technique of treatment by drainage and rest, it is important to emphasize the points that neither partial

<sup>1</sup>Flexner A. Medicine and Medical Education. New York: Macmillan Co. 1923 p. 5.

closure of the wound by stitches nor tube drainage comply with the requirements as the writer of this paper sees them

The rubber tube drain not only irritates as any other foreign body will do but serves as an inlet or carrier for infection. The partial closure of such wounds by sutures serves to cover up areas or pockets of infection and militates against sound healing of the wound as a whole. What is desired in such cases is to obtain granulation of a broad surface and a skin covering as in any other superficial wound.

The adoption of the method of wound treatment by drainage and rest meets with certain difficulties because it calls for a change in attitude on the part of surgeons toward this entire problem. The technical methods proposed although differently arranged, are not new. Moreover from the standpoint of most of us our methods heretofore have given us generally quite satisfactory results in other words we get by very well. There has been however a much larger percentage of unsatisfactory results than we realize. Because the patients do not complain very much and because our work is as good as the average does not indicate that we may not do much better.

I am reminded of a patient who was lumping out of the hospital at the end of the seventh week following what should have been an aseptic appendectomy. She thought she had the best surgeon in the world because although she had become infected at the time of operation (which she did not know) he had dressed the wound himself twice daily for the 7 weeks and she had finally recovered. Many of our cases of osteomyelitis pursue a course like this or worse and because life and limb are saved they think they have had the best possible surgical treatment.

Since the War period, more and more emphasis has been placed upon the surgical operation in chronic osteomyelitis. In chronic osteomyelitis, the operative method referred to by Ryerson as 'saucerization', or by Mebane as "excision" is the ideal procedure. This has the effect already referred to of converting a deep pocketed bone

abscess into a superficial wound healing occurring evenly from the bottom up and giving us much greater freedom from subsequent complications than has been customary heretofore.

Since the "rest treatment" as described by the author was first proposed one of the commonest questions asked has been with regard to his attitude toward acute cases. There are several important points that require consideration in the discussion of this matter. In the first place the disposition heretofore has been to employ methods that provide a minimum rather than a maximum of drainage. The popular methods have been those of an incision through the periosteum drill holes into the medulla and into the epiphysis only, and other procedures that might be called minimum rather than maximum.

There are in literature numerous assertions by competent observers to indicate that, if not at once, at least very early in practically all cases there is pus in the bone marrow. It has also been pointed out that drainage into the bone marrow in early cases will do no harm if pus is not encountered. We have had several illustrations of this point. In Case 3 an opening was made into the bone marrow and no pus was found. This case healed almost without drainage. It was significant that in this case pain swelling and other symptoms including a marked leucocytosis were markedly relieved within 48 hours. In this patient healing took place within a few months and she has had no recurrence.

Among the advantages which should be emphasized for the treatment of these conditions by drainage and rest alone, none is more important than the relief afforded the patient.

In children especially the infrequent dressings following an operation for osteomyelitis make the greatest possible difference not only in reducing the amount of suffering but in an improvement as to rest, appetite, and general condition. Even adults who stand frequent dressings fairly well are much more comfortable and seem to do better because of the relief from frequent disturbance of the wound.

If dressings are done at intervals of several weeks, instead of daily, it is quite possible for the surgeon to give the necessary time to see that his original ideas in regard to the position of the limb, splints, apparatus, etc., are strictly carried out and to have the dressings done under his own eyes so that proper rules of technique and after care are strictly observed.

All of these are matters of the greatest importance which, in using ordinary antiseptic methods have been neglected or overlooked. By the simple method of drainage and rest as described all of these points can be kept in mind and constantly observed.

The different effect upon the wound itself is shown by the fact that upon examining the wound for the first time two or three weeks following operation, there is found to be usually less discharge than is found at each dressing when they are changed frequently. This seems to explain why the absorption is less also when the infrequent dressing method is employed.

Naturally, there is a great saving in materials and labor, both the hospital and the attendants benefit by the fact that dressings are done at intervals of several weeks instead of daily or every few days. Furthermore, when dressings are done infrequently it is possible for the surgeon himself to become responsible for the postoperative care of the case. It has been entirely too common for the surgeon, immediately following operation in such cases, to shift the after care to other and less capable persons.

In the chronic cases, the dressings often get so far away from the surgeon himself that they are done by untrained hospital attendants or even by the patient himself or some member of his family. Secondary mixed infection has therefore been the rule, and the end results in such patients are almost certain to fall far short of what the surgeon had in mind at the time of operation.

Several surgeons who have employed the technique described by the author in the treatment of these cases have made the observation that, whereas the course of the disease following operation and immobilization is very favorable, there is sometimes

considerable delay in securing final healing in the late stages of the condition. A careful inquiry into the details of treatment in such cases reveals two important things. First of all, the patients themselves are seldom kept at rest during the late stages of these conditions. As soon as they begin to feel well enough they are allowed to be up and about with limbs hanging down and usually with a reduction in the amount of immobilization. It has been the author's opinion that activities of this sort delay healing and cause a considerable amount of swelling and congestion of the part. This swelling goes down at night and recurs next day. This alternate swollen and congested condition of the diseased area of a lower extremity, for example, certainly interferes with its repair.

It has also been noted that at this stage of the procedure, it is very common to permit some less experienced person to do the dressings. Dressings are also being done more frequently and a wound which has been kept fairly clean and at rest up to the end of 2 or 3 months, immediately takes on a different aspect with an inflamed, irritated surface due to the dressings having been changed by inexperienced persons.

The combination of these two things—decreased immobilization and an increased number of less sterile dressings—will serve to reduce any case to the condition in which these patients have almost always been found, namely, with chronic mixed infected wounds which are slow in healing or which do not heal at all. Such infection may, and usually does, penetrate into the deeper tissue of bone and give additional trouble where sound healing might have occurred if the principles enumerated above had been strictly adhered to.

Table I shows the results in a series of consecutive cases. Many recent cases are omitted as being incomplete.

Just as lives and limbs were saved on the battle fields of France by early immobilization of gunshot fractures in Thomas splints, so there is an opportunity to rescue those who are acutely infected with osteomyelitis, arthritis, and fractures, by prompt fixation in casts or other suitable devices. Drainage



TABLE I—RESULTS IN A SERIES OF  
CONSECUTIVE CASES

	W.C.	L.A.	I.C.	F.C.	(H)	D	H.D	E	H	H.H	K	C.K	K	L	L.M	L.M	M	M.L	F.A.M	O.M	I.M	I.M	L.I	K.O	V.I	H	I	R	A.R	S	E.J.S	E.S	D.M.S	S	S	R.S	F.S	F.T	T.T	M.T	R.C	I	T						
Age	1	2	3	4		5		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Sex	M	M	M	M		M		M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
Occupation																																																	
Duration of illness																																																	
Site of fracture																																																	
Time of day																																																	
Season																																																	
Weather																																																	
Complications																																																	
Results																																																	

is a matter that will often (but not always) take care of itself. If nature is left to do her own immobilizing life may be preserved but contracture, deformity and disability are invariably the result. Early ample drainage (but thorough) protection against bacterial invasion and fixation in correct position are

the principles of treatment for which adequate methods must be employed.

Our further development of a perfect and applicable technique must not be abandoned until our results are far better than are now being obtained.

#### ILLUSTRATIVE CASES

**CASE 1. L. H. H.** This patient sustained a fracture of the right femur in the middle third on March 22, 1926. He was removed at once to a hospital in a town 18 miles away. Several expedients were tried in an effort to place the fragments in correct position and to secure adequate traction. These having failed, an open reduction was decided upon and this was done on the eighth day. A Lane plate was applied but a traction table was not available and satisfactory position was still not obtained and the plate proved to be inadequate to control the position of the fragments. Furthermore an infection supervened and in a few days the patient was in great distress both because of failure to control the fracture and a rapidly increasing local and general infection. At this point the patient came under the care of the writer. A traction device was taken out to the patient (about two hundred miles) who was thought to be too sick for transportation. The patient was placed upon the traction table under ether and ice tongs were inserted into the condyles of the femur. Under strong traction upon both the foot and the ice tongs the leg straightened out and came down to full length. The wound was opened up widely, the steel plate was removed and with a small chisel used as a pun the fragments were brought into correct position. The chisel was driven in to secure the fragments during the application of the cast. Now the wound was wiped out very thoroughly with tincture of iodine and alcohol and packed with vaseline gauze. A dry gauze dressing was placed over the pack and a double spica cast put on. The patient was kept in bed with the foot of the bed elevated and instructions were given not to open the cast or disturb the dressings except for temperature, swelling or other signs of inflammation. About ten days later however there was some drainage showing through the cast and a little odor so it was opened up and daily dressings begun. Thereupon the temperature which had come down rose again and the discharge increased.

Following a telephone conversation the patient was transferred to Lincoln making the trip in his cast without much discomfort. The wound was cleaned up, repacked with vaseline, a cast applied and a policy of better immobilization and rest for the wound faithfully carried out. The local inflammatory and general symptoms quieted down and the wound went along to nearly complete healing. Solid union of the femur occurred. On June 30, 1926 the man was permitted to return to his home on furlough although it was pointed out to him

that there were one or two sequestra forming which would require removal later. Those sequestra have now been removed, the patient's general condition is excellent and he is recovering with a straight limb not more than one half inch short. (See Figs 1 to 7.)

CASE 2. T. T. I was called in consultation to see this boy after one month's illness in the hospital. He was in desperate condition with an extensive septic involvement of the entire leg extending to the knee. There was tremendous swelling of the limb as high as the hip and the boy was acutely septic. I was called in to decide the question of amputation and promptly advised against it as it was evident that amputation would cost the boy his life.

An extensive drainage operation for the foot and entire leg was done the same day. Previous drainage had been afforded only by incision through the skin and the soft tissue. Large windows were made in the bony structure of the tarsus and in the upper and lower ends of the tibia. A large sequestrum in the tibia was not removed until later. The wounds were packed wide open with vaseline gauze and the entire limb put in a plaster cast. The limb was put in suspension and traction at once.<sup>1</sup>

At the time of operation the entire leg was full of pus. For the first few weeks drainage was very profuse, at the same time dressings were very infrequent and the packs were not removed oftener than at intervals of from 2 to 4 weeks.

This boy was slow in recovering but left the hospital in about 10 weeks and since that time the wound has been dressed about once a month. He has had four or five changes of cast and is now wearing a caliper splint.

The photograph shows the condition at the end of 12 months. Both the leg and tarsus are practically healed at the present time. Attention is called to the range of motion in the knee which is within a few degrees of normal, this in spite of 8 months in a plaster cast.

The boy is now returning to school and gives every promise of having a useful limb. (Fig. 8.)

CASE 3. L. M. This patient came under my observation May 22, 1926. She had sustained an injury to the knee 6 weeks previously. The knee was considerably swollen. X-ray showed an area of destruction in the upper end of the tibia near and under the tibial tubercle. There was much tenderness and thickening at that point but no fluctuation. The knee was operated upon the next day and a softened area the size of a large olive was found on the inner side of the upper end of the tibia leading down into the head of the bone. This was opened widely but not curetted. The wound was packed wide open with vaseline gauze and the limb placed in a plaster cast, and was not dressed for one month.

<sup>1</sup> I consider it desirable to employ suspension in a Balkan frame and traction by means of weight and pulley for all patients with lower extremity osteomyelitis when it is undesirable to use a double plaster spica or a body cast. In small children or in patients difficult to control the double spica is to be preferred. In the upper extremity in children it is desirable to use the body and arm cast with the arm in abduction, the elbow flexed and the hand supinated. The ordinary aeroplane splint or recumbency with the Blake suspension device may be used.

The pain from which she had been suffering severely was relieved immediately and has not returned. The patient was highly neurotic and complained considerably about the cast which, however, was kept on for 3 months. After the third dressing the cast was removed and left off. In September the wound was pronounced healed and has remained healed. There is slight limitation of motion remaining, but she walks about attending to her housework and seems to be making a complete recovery. There is no return of inflammation, swelling or pain. (Fig. 9.)

CASE 4. R. H. This patient sustained a compound comminuted fracture in an explosion of a compressed air tank on December 1, 1925. The fracture was in the lower half of the tibia and fibula, and there was a considerable amount of comminution and deformity. The accident occurred on the day when the Central States Orthopedic Clinical Society was meeting in Lincoln and he was operated upon in the presence of some of the members.

Traction was applied on the Hawley table with a pin through the calcaneum. The leg was brought down to full length, the wound was cleaned up. No fragments of bone were removed as the small pieces were found firmly attached. The wound was allowed to remain open, however, and gently packed with vaseline gauze. No dressing was done until December 30, 1925. A little later X-ray showed that there was some lateral displacement of the fragments. A pin was introduced through the skin, the fragments manipulated into nearly correct position, and the pin was driven into the lower fragment, and the cast renewed in such a way as to hold the pin and fragments in this position.

During the next 2 months dressings were done twice, the pin in the meantime having been removed. All wounds were soundly healed at that time and there was beginning but not solid union. Complete bony union was somewhat delayed and the leg was not considered to be solid until after about 6 or 7 months. At about the seventh month he returned to work, not as a machinist but as a shoemaker, walking to and from work with the aid of a double lateral iron on his leg and crutches. He has continued to improve, the swelling of the limb has almost entirely subsided and at the end of the eleventh month he is solidly healed in very good position.

There is a small amount of shortening due partly to the bone defect and to the fact that exact approximation of the fragments could not be obtained. He has good ankle motion and weight bearing joint for the foot, and the leg is about 95 per cent mechanically correct. There is slight pronation of the foot due to a spreading of the leg bones at the ankle joint which could not be entirely controlled. This is corrected in walking by means of an inside wedge on the heel. (Figs 10, 11.)

CASE 5. W. C., age 19. This patient sustained a simple fracture of the lower third of the humerus in March, 1923. The first treatment failed to give

union and four times in 1924 and 1925 operations were performed. Three months before coming to the hospital in Lincoln another operation was performed and the fragments strongly wired together. Infection unfortunately followed this last attempt and when seen by us there was not only non union and some deformity, but a stiff elbow and an osteomyelitis involving the entire lower half of the humerus. The patient was in poor general condition.

Our operation (September 18, 1925) consisted of removal of all the wire and two sequestra through a generous incision. The entire wound was packed widely open with vaseline gauze and a body and arm cast put on with the arm well abducted, the elbow flexed and the hand supinated. Following operation the wound was dressed and he was permitted to return to his home in Kansas. Four weeks later he returned for another dressing. The wound was almost healed and about 6 weeks later was found quite healed. While in the cast there seemed to be some improvement in stability at the point of fracture and it was determined to stimulate bone production by chipping off a few fragments at the end of the fracture fragments. Through a window in the cast and subcutaneously (outside the scar area) a small chisel was inserted down to the fracture region and with a mallet a few pieces were chipped off and placed in the space between the ends of the bones. As expected a certain amount of inflammation followed and a small abscess formed which pointed near the olecranon. This was incised and drained and healed in a few days. To our great interest we found at the end of the next 6 weeks that definite callus was forming and on April 16, 1926 the cast was removed and good union was found to have occurred. A splint was kept on until December 18, 1926 but at the present time the young man is doing light work and using the arm to drive a car and for many other purposes. It is expected that later on an arthroplasty of the elbow can be done to restore motion to the elbow. There has been no recurrence of the inflammatory process. (Figs 12-13.)

CASE 6 No. 1005 R S age 6 years. This child came 250 miles on the train and was admitted to the hospital September 1, 1926 with a temperature of 103 degrees pulse 140 respiration 32 white blood count 28,000. There had been pain in the knee and thigh for 3 days previously. Hot packs had been used to allay the discomfort but during the last 24 hours the least movement of the left lower extremity caused severe pain. The temperature when last taken 12 hours before admission to the hospital was 106 degrees and had been 104 degrees the day before.

The lower third of the left thigh was swollen and tender. There was a definite redness radiating to the outer side of the front lower portion of the thigh. Movement of the knee or hip caused severe pain. The child was negative as to other physical findings except for mild furunculosis on the back of the neck and infection of one finger. X-ray findings were negative as to any bone lesion.

The child was taken to the operating room with a diagnosis of acute osteomyelitis of the lower third of the femur. (Operation by Dr. J. E. M. Thomson, Dr. Orr consulting surgeon.) An incision was made laterally just behind the quadriceps group about 6 inches long. The skin, muscles and periosteum were reflected and a small chisel hole made in the cortex of the metaphysis just proximal to the epiphyseal line. Immediately a yellow creamy pus welled out. The opening in the bone was extended to about 3 inches long and one half inch wide so that the entire lower third of the femur was well drained.

Pus exuded freely and was apparently under pressure. Very little curetting of the medullary cavity was done and the wound was filled to the depth of the medulla with a vaseline gauze pack and a double plaster-of-Paris spica cast was applied. In 12 hours his temperature had dropped to 99 degrees. It went up in the afternoon to 101 degrees but was down the next morning. The temperature ranged within these limits for 3 days after that the temperature remained under 99.6 degrees for 4 days after which he had a normal temperature once or twice rising to 99 degrees and a fraction.

At the end of 6 weeks the cast was removed and the dressings taken out. There had been considerable drainage under the cast but upon removal of the vaseline pack the wound had filled in to practically one half the previous depth and was covered from the base with healthy granulation. A new single spica cast was put on and worn for a month longer when it was removed and the wound was found to be healed with the dressings pushed entirely out of the wound and the serum which had come from the wound entirely dried.

This wound which had gaped open originally about 2 inches is now closed to less than one half inch at the widest portion of the scar. He was placed in a double lateral iron brace and physiotherapy, massage, active and passive motion instituted. Since he has been up and around he has had no temperature and is now (January 10, 1927—date of photograph) apparently entirely well.

It is desired to acknowledge assistance in the clinical work by Miss Gertrude Krausnick and Dr. J. E. M. Thomson and in preparation of the manuscript by Dr. Arthur Steindler and Dr. Philip Lewin.

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# MESENTERIC LYMPHADENITIS SIMULATING AN ACUTE ABDOMINAL CONDITION<sup>1</sup>

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**T**UBERCULOSIS of the mesenteric lymph nodes, *tuberc mesenterica*, was recognized as a clinical entity by the German and French writers in the early part of the nineteenth century. The clinical picture, as given by these writers, is confused, and undoubtedly includes many cases of tuberculous peritonitis, malnutrition, and rickets.

In 1895, Maurice Richardson of Boston first successfully removed tuberculous ileo cæcal glands found at operation. In 1899, J. W. Elliott and Marchant also described the operative procedure for this condition. The classification of retroperitoneal lymphadenopathy received little careful study until 1919.

## FREQUENCY OF OCCURRENCE

Statistics of the occurrence of glands noted at abdominal exploration, gathered from numerous surgeons show a wide variation in the percentage and it is only within the last 7 years that careful search for retroperitoneal lymphadenopathy has been made at the time of exploratory laparotomy. When surgeons are on the lookout for the presence of diseased glands, larger numbers will be demonstrated.

Most authors agree that, in the greater number of cases retroperitoneal tuberculosis and lymphadenopathies of questionable tuberculous origin, are diseases of early childhood and young adult life. Corner believes that tuberculous mesenteric glands are to be found in practically every child upon whom an abdominal operation is necessary. Risley believes the disease to be extremely common in infancy and childhood, but by no means confined to this period, being nearly as common in young adults. He notes that the highest incidence is found in patients between the ages of 16 and 18 years. Floderus, Gersets and Struthers found most of their reported cases of mesenteric lymphadenitis in children and young adults.

The autopsy statistics of Eisenhardt, Ronseff, and Harnan, on persons who had suffered from pulmonary tuberculosis, show from 50 to 68 per cent occurrence of retroperitoneal tuberculosis. In fifteen thousand post mortem examinations, Keiler found tuberculous retroperitoneal glands in 1 per cent. Bertzke presented similar figures. Osler and McCrie state that Boyard, at the Mt. Sinai Hospital, New York, found the incidence at post mortem to be less than 1 per cent, while John Thomson reports it as 3.54 per cent for Edinburgh and 4.51 per cent for Glasgow. Opie finds a much lower incidence in St. Louis.

The above figures substantiate Braithwaite's assertion that different localities and countries have a greatly varying percentage in the incidence of retroperitoneal tuberculosis. He finds the disease more common in his private than in his dispensary practice.

## ETIOLOGY

In 1917 Frankel stated that intestinal tuberculosis was rare in infants (9 months to 1 year old) but gradually increased in frequency to the fourth or fifth year and then diminished again. This term coincides with the average time of weaning and the change from mother's milk to the diet through which contaminated food has an opportunity to invade the intestinal canal.

Braithwaite has definitely traced the use of infected milk as a cause for the disease in a number of his patients. Shrota, reporting 24 cases from Japan, makes the interesting observation that none of the patients had drunk milk.

It is generally accepted that there is a higher percentage of incidence of the bovine type of the organism. The bacilli are taken into the intestinal canal in milk or milk products from tuberculous animals. The human type is usually acquired by sputum

<sup>1</sup>From the Department of Surgery, Woodland Clinic.

being swallowed by persons suffering from pulmonary tuberculosis

#### MODE OF ENTRY OF INFECTION

The factors causing the ileocecal region to be more susceptible to the entry of microorganisms of tuberculous or non tuberculous origin are stasis distention of the bowel catarrhal inflammation mucous abrasions and lowered resistance of the surface epithelium caused by bacterial toxins. Carson believes that infection occurs through a breach in the intestinal mucosa and the lowered resistance of the mucosa from previously existing toxins and general sepsis. Walsham, Philip and Morley are inclined to believe that infection may pass through mucosa which is intact or may arise from primary ulcers in Peyer's patches.

There seems to be an exact analogy between the anatomical arrangements and relationship of the cervical lymph nodes and the lymphatic apparatus of the neck and those of the mesenteric glands and the intra-abdominal lymphatic apparatus. In both the pharynx and the wall of the terminal ileum masses of lymphadenoid tissue have collected which in the neck are tonsils and in the terminal ileum are the Peyer's patches. In either instance the lymphadenoid collections in the wall of the alimentary canal (tonsils Peyer's patches) form the first point of blockage and filtration of the lymphatic stream and the cervical and mesenteric nodes form the second points. It is assumed that Peyer's patches like the tonsils form the point of entry for the infecting bacteria. For some unexplained reason the glands closer to the source of infection apparently are more resistant to the organisms even though they are closer to the site of the septic invasion. The smaller glands do not function in straining bacteria from the lymphatic stream to the same extent as the larger

Pagenstecher states that the order of incidence is first, ileocecal glands second those at the root of the mesentery third those of the ascending colon, and fourth those of the sigmoid. The glands at the root of the mesentery receive most of the lymphatic

drainage and are for that reason frequently infected (Figs 1, 2 3)

#### PATHOLOGY

The pathological process of the proved tuberculous lymph nodes is similar in every respect to the tuberculous lymph nodes in other parts of the body. The findings at any certain time are dependent upon the stage of the process and the course is governed by the ratio between the virulence of the organism and the resistance of the individual.

At the present time there are differences of opinion among various authors as to whether the tubercle bacillus is the etiological factor in all the cases of mesenteric lymphadenitis which simulate an acute abdominal condition. Symmers states that tuberculous lesions in the intestine and elsewhere are capable of producing simple hyperplastic changes in the mesenteric lymph nodes without the occurrence of tubercles. These hyperplastic changes being caused by the absorption of toxins from the ulcerated gut or Peyer's patches. Walsham, Philip and Morley concur in this opinion.

Wilensky has recently raised the question as to whether mesenteric lymphadenitis which after pathological study and laboratory tests showed no evidence of tuberculosis in the excised gland might not be due to pyogenic infection other than tuberculosis.

Struthers feels that most cases of mesenteric lymphadenitis in which the tubercle bacilli have not been demonstrated are nevertheless caused by reactions provoked by the invasion of that organism.

Braithwaite believes the tubercle bacillus to be the infecting organism in all cases of mesenteric lymphadenitis. He divides the clinical picture into five classes considering the first class as simple hyperplasia without demonstrable tubercles or bacteria. The intermediate classes represent the progress from hyperplasia through suppuration caseation and final calcification.

Wilensky divides the process into (1) simple mesenteric lymphadenitis (2) suppurative mesenteric lymphadenitis (3) tuberculous lymphadenitis and (4) the terminal stage of mesenteric lymphadenitis.

It is unfortunate that, in most operative cases careful pathological and bacteriological examinations have not been made. Heusser, in a report of 40 cases, finds a certain number of the simple hyperplastic glands in which no tubercle bacilli can be demonstrated by guinea pig inoculation, cultures, or use of the antiformin method.

Suppurative mesenteric lymphadenitis does not occur in acute appendicitis, enteritis, colitis, typhoid fever, or secondary to intestinal parasites. We are therefore confronted with a definite group of cases occurring to the greatest extent in childhood and early youth, the greatest percentage of which can be definitely proved to be tuberculous infections. At the time of exploration, several patients have had a diagnosis of hyperplasia. At a later date caseous glands have been removed.

Therefore, until proved otherwise, it is logical to assume that they are all reactions provoked by an extension of tuberculous infection. In these cases of simple hyperplasia, if the existence of tuberculous infection is to be definitely proved, numerous glands must be excised and subjected to careful pathological and bacteriological study. Very few surgeons wish to subject their patients to unnecessary risk by the excision of numerous glands or by opening the bowel to look for primary ulcerations in the mucosa. The absolute proof can seldom be assured. The assertions of Braithwaite and Symmers that these hyperplasias are due to toxic absorption from ulcerative tuberculous lesions in the mucosa are the most logical.

#### SYMPTOMS

It is impossible to establish a definite clinical picture. This disease presents the characteristics of an acute abdominal condition and is best described as acute, and chronic with acute exacerbations. The resistance of the individual to tuberculous invasion is the factor which determines the outstanding symptoms.

Acute mesenteric lymphadenitis usually has a sudden onset with tenderness and rigidity of the abdominal muscles more pronounced over the right lower quadrant.

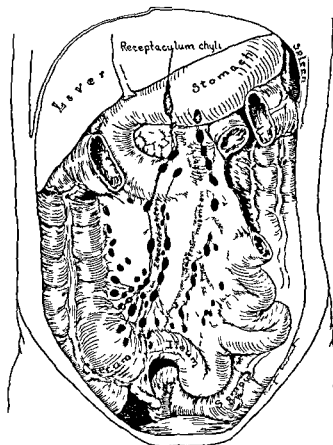


Fig. 1. Normal lymphatic drainage of cecum and terminal ileum illustrating the cecal drainage and the greater portion of the small bowel. The lymphatic drainage empties into the receptaculum chyli at the level of the second lumbar vertebra. The black areas represent the superficial and the grey areas the deep glands.

Vomiting usually ensues. The pulse count is 100 to 120 and the temperature varies from 100 to 103 degrees F. The white blood count will be found to vary from 12,000 to 15,000. In the less acute cases there is moderate tenderness over the right iliac fossa with less systemic reaction. The pain experienced is usually paroxysmal in type, is severe enough to double the patient up, and cause him to cry with pain. It lasts about 5 minutes, recurs 2 to 5 times daily and stops suddenly. During the intervals, the patient is usually comfortable. Carson believes that the pain is caused by a reflex spasm of colic incited by irritation of the vagus filaments in the mesentery.

The general impression given is that of a severe systemic reaction without the marked physical findings which one would expect. The acute symptoms usually subside in 2 or 3 days.





Fig. 2. Mass of glands around cecum and terminal portion of ileum.

In the chronic forms the initial symptoms are usually pain intermittent in character which may be vague and transitory colicky and recurrent or of the drawing and dragging type. The pain is usually on the right side although it may be anywhere in the abdomen. Vomiting is often a symptom. Chronic forms very often have acute exacerbations caused by superimposed secondary infections which lower the patient's resistance. Risley in a review of the records of 65 cases in which tuberculous mesenteric glands were found at autopsy found that none of the patients in this series had complained of abdominal pain as a symptom. These findings would lead one to believe that many individuals are infected in early youth but overcome the in-

fection without the toxin absorption having caused more than hyperplastic changes in the glands. If the tuberculous infection has gained sufficient foothold in the tissues of its host and a partial immunity is established its progress is arrested or very appreciably slowed. A lowering of resistance by general or chronic systemic infection may activate the dormant process. The clinical picture then becomes one of recurring periods of activity with acute abdominal symptoms.

The patient is often undernourished and appears subnormal as to strength and endurance is usually anemic and listless and has a poor appetite. However quite an appreciable number show very little physical sign of weight, strength or appetite loss.

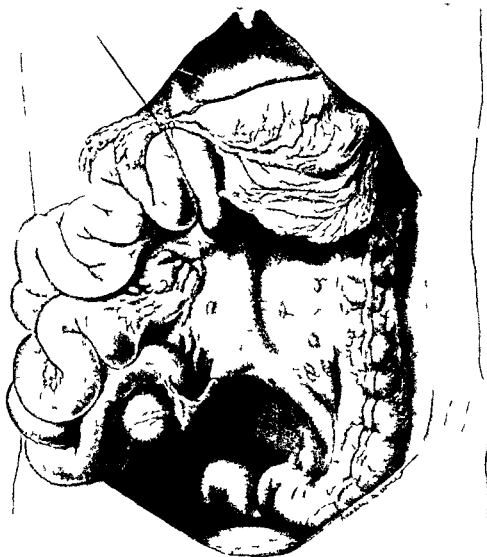


Fig. 3. Mass of glands at root of mesentery of small intestine with a few enlarged glands in mesentery of descending colon.

Different authors have reported masses of variable sizes as palpable in the right lower quadrant. In our series we have not been able to substantiate this as a diagnostic symptom. There is usually a daily rise of temperature in the afternoon and there may be evidence of other tuberculous foci such as enlarged cervical glands, scars on the neck, tracheobronchial lymphadenitis or signs of latent or active pulmonary lesions.

The secondary complications may be those of ileus, erosion, abscess formation, sometimes with rupture, disturbances from pressure on other organs, and miliary tuberculosis. Hemorrhage, mesenteric thrombosis, and obstruction of the common bile duct are rare.

#### DIFFERENTIAL DIAGNOSIS

In children and young adults suffering from retroperitoneal lymphadenitis, it is often impossible to make a diagnosis other than that of an acute abdominal condition. An X-ray diagnosis can sometimes be made if the glands are caseous or calcified. When the condition is acute, the diagnosis is occasionally suspected but is seldom positive because of the very striking resemblance to acute appendicitis. In children, appendicitis, pyelonephritis, Meckel's diverticulitis, acute, and intussusception are usually considered. In young adults and adults, chronic appendicitis, gall bladder disease, pyelonephritis, and intestinal or peritoneal tuberculosis are to be considered. There is no disease quite so

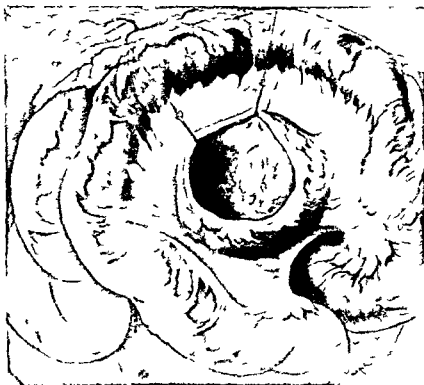


Fig 4 Ruptured tuberculous abscess in root of mesentery of small intestine of the upper jejunum. Marked fibrinous peritonitis

treacherous as acute appendicitis especially in children. Delay in exploration of the abdomen may cost the patient's life by rupture of the appendix. For this reason immediate exploratory laparotomy is imperative if acute appendicitis is suspected.

#### TREATMENT

The treatment may be medical or surgical after a definite diagnosis has been made. In relatively few cases is this achieved before exploratory laparotomy. The pathological complications are so varied that abdominal exploration should be resorted to in all cases.

The medical treatment in our series of cases has consisted of high caloric diet, rest and out of door life. Quartz mercury lights are used for the anæmic patients suffering from the chronic form of mesenteric lymphadenitis.

Opening the abdomen apparently has a beneficial effect as the greater number of patients promptly regain their health. Those

who have recurring attacks with acute exacerbations are given X-ray treatments. Such treatments are of great value in the treatment of tuberculous cervical lymphadenitis before suppuration has occurred and it is reasonable to believe that such therapy is indicated for cases of marked mesenteric lymphadenitis without suppuration or caseation. The use of tuberculin is, as a rule of little value. Abscessed and caseous gland should be incised, curetted and their walls enfolded (Fig 5).

#### REPORTS OF ACUTE CASES

Because of the number of cases (14 in both groups) and the space their reports would occupy only those illustrative of the types of mesenteric lymphadenitis will be given in detail.

CASE 2 G. R. female age 9 entered the hospital on September 20, 1926 with the complaint of pain in the abdomen and nausea. At the age of 8 she had had influenza lasting one week complicated

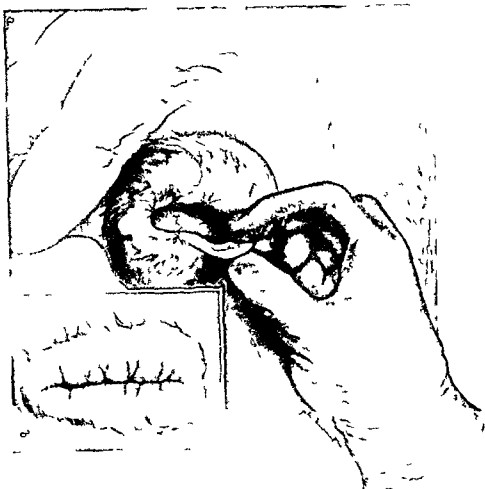


Fig 5 A Placing of interrupted sutures in repair of tuberculous abscess cavity  
B Final closure with interrupted chromic catgut

by otitis media. One month ago, she had had an attack of pain with vomiting. On the day of admission to the hospital the child was awakened by pain in the region of the navel, the pain was gradual in onset, severe and colicky with nausea, vomiting, and tenderness to pressure over the abdomen.

Some tenderness and spasticity were present on the right side of the abdomen, the temperature was 99.6 degrees F. Urinalysis was negative except for a few red blood cells and a trace of albumin. White blood count 14,000, polymorphonuclears, 89 per cent, small lymphocytes, 9 per cent, large mononuclears, 2 per cent.

**Operation** September 20, 1926. Chronic appendicitis and many mesenteric glands were found, the glands varying in size from shot to almonds, the larger number being in the caecal area. Some glands, to the sense of touch, seemed irregular and calcified. The pathologist reported old healed tuberculosis of the gland excised, and chronic appendicitis.

The patient was dismissed on October 3, 1926, and on December 3, 1926, was reported in good condition. In February 1927 the parents reported slight attacks of abdominal pain. The child is gain-

ing in weight and strength and her progress is satisfactory.

**CASE 5** H R, male, age 2 entered the hospital October 14, 1925. The past history was negative.

On October 14, 1925, without evidence of previous nausea or pain, the child suddenly vomited just before dinner. He had no fever. He vomited again at midnight and often through the rest of the night. There was no distress between attacks of vomiting.

The child looked ill but there were no other positive physical findings. The urinalysis was negative. White blood count, 10,060 polymorphonuclears, 83 per cent, small lymphocytes, 14 per cent, large mononuclears, 3 per cent.

**Operation** October 17, 1925 showed intussusception at the junction of the jejunum and ileum, with very marked mesenteric lymphadenopathy. The pathologist returned a report of an inflammatory gland. This child had a stormy convalescence but was discharged in good condition on November 6, 1925. He was seen on January 8, 1926, and appeared entirely normal.

At the time of writing, his condition is entirely satisfactory.

This group consisting of 6 cases of which only 2 are reported illustrates the very acute onset of the disease with the general picture one of severe illness. One case which was not operated upon showed tuberculous meningitis as well as tuberculous mesenteric lymphadenitis at post mortem examination. Intussusception has been noted as a complication by numerous authors.

#### REPORTS OF CHRONIC CASES WITH ACUTE EXACERBATIONS

**CASE 8.** P. W. D. a male age 9 entered the hospital on August 9, 1925 complaining of pain in the right lower abdomen and vomiting. The patient had had two previous attacks of pain in the right lower quadrant of the abdomen with fever and vomiting. The present illness began with continuous pain on August 6, 1925. The temperature was 103.6 degrees F, pulse rate 120, the tonsils were large and red, tenderness over the entire abdomen was especially marked in the right lower quadrant and in the left lower quadrant moderate rigidity was noted with no masses. The spleen was palpable beneath the costal margin. The white blood count was 8,100 polymorphonuclears 81.5 per cent, small lymphocytes 17.5 per cent, large mononuclears 1 per cent.

**Operation.** Chronic appendicitis, many large clusters of inflammatory retroperitoneal glands, glands of the mesentery and small bowel. The pathologist reported subacute mesenteric lymph nodes without suggestion of tuberculosis.

X-ray treatment was given on August 21, 1925 and the patient was dismissed the following day still with some rise in temperature. On August 24 another X-ray treatment was given. The patient gained about 10 or 15 pounds and was entirely well until about October 8, 1926. He re-entered the hospital on October 18, 1926 with the complaint of cramps, vomiting and fever of 10 days duration. At the time of entry the physical examination was negative except for abdominal tenderness and distention, temperature 104, white blood count 14,400 polymorphonuclears 78 per cent, small lymphocytes 10 per cent, large mononuclears 1 per cent, transitional 11 per cent. X-ray therapy was given and the patient was dismissed on October 13, 1926 with a normal temperature. Another X-ray treatment was given on November 6, 1926. On January 6, 1927, the boy's mother reported that he still had attacks of pain in the stomach and head for 3 or 4 days every 2 or 3 weeks but that the attacks were not severe. At the time of writing his condition is very satisfactory.

**CASE 14.** W. S. male age 31 entered the hospital on April 10, 1926 complaining of indigestion and nervousness and pain in the left upper quadrant colicky at times.

The patient had had recurring attacks of abdominal pain since childhood; he had been pale and sickly in childhood. He had had influenza in 1922 but not a severe attack. Constipation had been severe and continuous since 1908 with gas and sour stomach a half hour after meals. The symptoms could be occasionally relieved for two or three days and would then return. Pain was noted under and over the heart and indigestion without nausea or vomiting. In April 1925 he had an attack of sharp colicky pain which lasted about one week and was cured by diet. No other attacks of acute pain were reported. The physical examination was negative. The X-ray showed a possible gastric ulcer. White blood count 9,000 polymorphonuclears 70 per cent, small lymphocytes 3 per cent, large mononuclears 7 per cent. The urinalysis was negative. The patient was given an ulcer diet which relieved his symptoms (patient neurasthenic) and he was discharged from the hospital on May 1, 1926. He was put on a regular routine and gained weight and strength. On January 17, 1927 he re-entered the hospital complaining of great abdominal pain. He had fallen 15 feet. The abdomen was distended and tympanitic and there was much blood in the urine.

**Operation.** At the root of the mesentery was found a ruptured tuberculous cyst, wall the size of a baseball. A portion of the cyst was removed for diagnosis and the pathologist reported inflammatory hyaline and fibrous tissue without evidence of epithelial tissue. A culture of pus from the cyst was negative. There was a generalized enlargement apparently tuberculous of the mesenteric glands, some one inch in diameter. The largest were in the root of the mesentery. No glands were caseous. About one pint of flaky caseous material was removed by aspiration from the abdomen. Ileostomy and aspiration of the small intestine were done because of paralytic ileus and obstruction of the small bowel (Figs. 4 and 5).

In this group of 8 cases the extreme chronicity of the condition is shown. The usual syndrome is vague intermittent attacks of abdominal pain over long periods of time. Because of the continued pain the condition is demonstrated by an exploratory laparotomy.

The complications in this group were obstruction of the duodenum by a mass of glands at the ligament of Treitz in one instance and 'giant cell hyperplasia' or pseudo Hodgkin's disease reported by the pathologist in another instance. In the latter case the patient is now entirely well.

There is probably no other type of disease so widely disseminated in the animal kingdom as tuberculosis. Man is continuously exposed

to infection from contact with his fellow men suffering from the disease and from the infected food which he ingests. That he often succumbs to it is proved by our death rate from tuberculosis. That he overcomes the infection or holds it stationary is shown by post mortem examinations.

When dealing with such a very widely disseminated disease, we must ever keep it in mind.

The clinical picture of enlarged cervical bronchial, or mesenteric glands should suggest it.

## SUMMARY

1. All cases of mesenteric lymphadenitis should be treated as tuberculous until proved otherwise.

2. All cases of suspected mesenteric lymphadenitis, either acute or chronic, should have an exploratory laparotomy because of the various pathological complications which may exist and the extreme danger of failure to diagnose acute appendicitis.

3. Heliotherapy should be given for those patients who do not promptly respond to sunlight, rest, and a high caloric diet.

4. X ray therapy is of great value in the acute form and in the chronic form with acute exacerbations where there is marked glandular enlargement without caseation. Because of the cost of X ray treatment, it is not suggested as a routine.

5. Operative removal of glands should not be undertaken except for pathological examination, unless the glands are caseous or are abscessed.

6. The examination of the mesentery for enlarged glands should be a routine whenever an abdomen is opened.

7. Tuberculous mesenteric glands are common in various stages of disease without symptoms. Activation is caused by environmental and hygienic conditions, physical exercise, or intercurrent superimposed infec-

tions which lower resistance to the invasion of tubercle bacilli.

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CHOLECYSTOGASTROSTOMY FOR GASTRIC ULCER<sup>1</sup>

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IN the recent surgical literature much attention has been given to the problem of the treatment of round gastric ulcer but the final word has not yet been said. Several methods of surgical treatment have gained general recognition. Some of them such as gastro-enterostomy have been proved valuable by abundant clinical material while others neither less scientifically correct nor less expedient perhaps must be given further trial before they can be generally accepted. We have in mind cholecystogastrostomy which as an operation for gastric ulcer is excellent in theory but has not been extensively tested clinically and experimentally.

In Russia in 1905 Professor Bogoraz<sup>2</sup> was the first to advocate cholecystogastrostomy as a means of controlling one of the principal conditions for the development of gastric ulcer namely hyperacidity of the gastric contents. His idea to attain prolonged neutralization of acid contents by a continuous flow of bile into the end of the stomach was justified by the excellent post-operative results achieved by him in his 25 cases.

We have reasons to believe that neutralization of the acid contents would be more apt to occur after cholecystogastrostomy than after gastro-enterostomy because cholecystogastrostomy augments the tendency of the body to neutralize high acidity by throwing an alkaline mixture chiefly bile from the intestine into the stomach. This fact has been established in the writings of some of the surgeons belonging to Porlov's school (Boldirev). Long ago Dastre, Oddi, Cannac and Masse in animal experiments arrived at the conclusion that bile sidetracked to the stomach produces no noticeable digestive disturbances.

In 189 Wickhoff and Angelberger performed a cholecystogastrostomy on a man with a tumorous obstruction of the bile duct. In the literature up to 1918 over 100 cases of

cholecystogastrostomy for obstruction to the bile duct were reported. In most of these cases the obstruction was a malignant growth. But at present cholecystogastrostomy is advocated as a method of treatment for round gastric ulcer.

We have performed this operation in 32 cases of gastric ulcer. The end results were satisfactory and were reported at the seventeenth congress of Russian Surgeons at Moscow May 1926. After the operation the patients were free from symptoms and were able to resume their occupations. The gastric juice was analyzed at various periods during the course of 1½ years and a decrease in acidity and the constant presence of bile (macroscopic) found.

We do not intend to give here a detailed account of all our material as it was included in the published report of the Congress.<sup>2</sup> The purpose of the present paper is to report the observations made at the secondary laparotomies done upon 4 patients who had previously undergone cholecystogastrostomy for gastric ulcer. We give here short extracts from the clinical histories of the 4 cases.

CASE 1. T. V. male aged 45 admitted to the clinic on May 13, 1923, suffered great pain in the region of the stomach. He had been disabled for 2 months. Clinical examination revealed gastric ulcer. Repeated investigations showed high acidity of the gastric contents. At operation a large indurated ulcer was found on the lesser curvature. A cholecystogastrostomy was done. EXAMINATION made at the clinic 3 months after operation showed no pain and a decrease in acidity. But after 6 months pain of the old character recurred and hyperacidity was present again. A second operation was done and the abdominal cavity opened. The anastomosis between the gall bladder and the stomach measuring 1 centimeter that had been sutured in during the first operation was found constricted. A new anastomosis measuring 1.5 centimeters was made. The infiltration at the site of the ulcer was found considerably diminished. The patient was discharged as cured. After 6 months he came back complaining of the return of pain in the region of the stomach. A secondary

laparotomy was done and the anastomosis, examined through the incision in the stomach was found so constricted that the point of closed Kocher forceps could hardly be inserted. The opening was therefore dilated with bougies until the index finger could be inserted. No infiltration would be palpated at the site of the ulcer. The acidity was lessened. Recovery resulted, and for the last 6 months the patient has been enjoying good health.

CASE 2. T. J., male, aged 37, was admitted to the hospital with severe pain in the region of the stomach and high acidity of the gastric contents. The condition was diagnosed as gastric ulcer. At operation under novocain, a large, indurated ulcer was revealed on the lesser curvature. A cholecystogastrostomy was performed and the anastomosis measuring 2 centimeters, was sutured in. Within the first months following the operation pain disappeared and the acidity diminished. After 5 months pain returned with its former acuteness and infiltration of the ulcer was not lessened. The tip of a sound could scarcely be passed through the anastomosis. A gastro enterostomy was performed and the pain disappeared. The patient recovered and gained 16 kilos in weight within 2 months after the operation.

CASE 3. T. V., male, aged 52, on admission suffered from gastric ulcer with hyperacidity of the gastric juice. The operation revealed an indurated ulcer on the lesser curvature. After cholecystogastrostomy the patient was discharged as cured. After 9 months he returned the pain being as great as before. Acidity of the gastric juice was again increased. He was subjected to a secondary laparotomy, and a carcinoma was found occupying the site of the former ulcer and extending over the entire area of the anastomosis. Resection could not be undertaken for several reasons. The patient left the hospital in a somewhat better condition.

CASE 4. M. K., male, aged 24, was admitted with gastric ulcer and high acidity of the gastric contents. The operation revealed a small, soft ulcer on the lesser curvature with infiltration 1 centimeter in diameter. Recovery followed cholecystogastrostomy. Pain totally disappeared and the acidity of the gastric contents diminished. After 5 months the patient returned to the clinic with an acute form of appendicitis. The appendix was removed through an incision starting at the costal margin and running parallel to the external margin of the rectus muscle. The anastomosis between the gall bladder and the stomach admitted the passage of a bougie and no adhesions were present. The former ulcer was impalpable and no infiltration could be noted at its former site. The patient recovered and was discharged as cured.

From the referred data, definite conclusions as to the value or shortcomings of the method cannot be drawn. However, these cases, with repeated operations, afford

a basis for valid practical inference. It is obvious that the anastomosis at cholecystogastrostomy has to be of sufficient length—not less than 2 to 3 centimeters—otherwise in a short while we may expect to find constriction, increased acidity of the gastric contents, and the recurrence of symptoms of ulcer.

In Cases 1 and 4, when we investigated the gall bladder with a finger inserted through the anastomosis, we found no trace of food remnants. The danger of food getting into the gall bladder cannot be considered serious. We may admit that the anastomosis assumes the function of a sphincter, the sucking action of the stomach forcing the bile into the stomach when it is needed. The abundance of bile found during digestion in the stomachs of the patients operated upon would seem to indicate that this could occur. However, it is hardly probable that food could easily pass into the gall bladder.

In Cases 1 and 4 we found that infiltration at the site of the ulcer disappeared after cholecystogastrostomy. The inflammatory induration at the site of the ulcer had absolutely disappeared within 6 months after the operation. This was probably due to the decrease in the acidity of the gastric contents brought about by the admittance of bile.

Cholecystogastrostomy should not be undertaken in cases of large, indurated ulcers (Cases 2 and 3), as there is a possibility of cancerous degeneration. In Case 2 the indurated ulcer remained in the same condition 5 months after the operation. In Case 3 we found after 9 months an unmistakable carcinoma at the site of the former ulcer. In these cases resection of the stomach is the operation of choice.

We are coming to the conclusion that cholecystogastrostomy is contra indicated in cases of ulcer with only a little soft infiltration, that is, in the cases in which, up to the present time, the majority of surgeons considered gastro enterostomy the operation of choice. In these cases cholecystogastrostomy has many advantages over gastro enterostomy.

1 Cholecystogastrostomy is a technically simpler operation.



2 It does not involve any of the serious complications resulting from gastro enterostomy in certain cases

3 It is more nearly physiologically correct and more logical

We have to add that the method advocated by us is new and has not been proved suc-

cessful in a large number of cases, but the results obtained in the cases which we were able to follow for a year and a half seem to us highly satisfactory. We therefore believe that cholecystogastrostomy may become the operation of choice in certain cases of gastric ulcer

## ORTHOPEDIC RECONSTRUCTION WORK ON HAND AND FOREARM

### REPORT ON EARLY AND LATE RESULTS<sup>1</sup>

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IN reconstruction work on chronic disabilities of the upper extremity the plan obviously must be based on the physiological and mechanical principles of normal function. This does not mean that the essential pathological conditions can be ignored. But in most cases the disability represents a remote deforming process which has terminated in a definite stage of biological cure in which all tissues have come to a state of rest. Therefore we find that all plans of reconstruction have been shaped according to the musculomechanical factors involved and the operative indications determined by physiological laws. The principal aims of reconstruction of hand and forearm mechanically and dynamically formulated are as follows:

Active supination of the forearm must be made possible in order that the hand be able to turn an object.

The wrist must be provided with a sufficient degree of stability in a suitable position of hyperextension; this forms the mechanical basis for the function of the fingers.

Finger flexion for the grip and extension for release are of almost equal importance as efficiency records show, and an active equilibrium between both actions is an important prerequisite.

The same is true of thumb function; the degree of opposition and adduction necessarily being determined by the ability to extend or adduct.

These cardinal postulates for hand and forearm again invoke definite dynamic requirements for elbow and shoulder inherently necessary for the function of the hand. By analyzing the intricate functions of the extremity into its principal components and by recognizing their share of importance for functions operations can be devised and performed which will correct certain definite points and the operative material can be clarified accordingly.

The operative side of reconstruction work, however, is only a part of the whole scheme and not always the most important one. The greater burden always rests upon the postoperative re-education.

The report here submitted supplements others made upon the reconstruction of the whole extremity 3 years ago. It is however confined to the hand and forearm alone and embraces 50 patients with a total of 450 operations. The opportunities of longer post-operative observation and of additional experiences allow of more definite conclusions in certain conditions; other problems still appear unsolved.

Of the larger number of disabilities which constitute this series 8 types have been chosen for this report. According to whether the correction of the alignment or restitution of motion form the principal object of a particular operative procedure, the series is again subdivided into 4 types representing principally restoration of form and 4 rep-

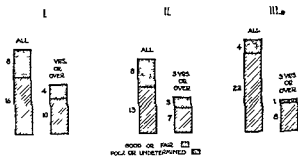


Chart 1 Restoration of form Group A wrist flexion contracture 1 Arthrodeses for spastic wrists 24 cases, 21 tenotomy and tenoplastic operations for spastic wrists 21 cases 311 tenotomies and tenoplastic operations for ischaemic and congenital contractures 26 cases total 71 cases

representing restoration of function. Our object is not so much the presentation of the merits of a single operation as that of combinations of operations.

#### RESTORATION OF FORM

*Group A Flexion contracture of the wrist*  
The first mechanical postulate for the function of the fingers is to place the wrist in hyperextension. The desired result is secured by one of three methods depending upon the type of case.

1 Correction by arthrodesis of the wrist was used in 24 cases of spastic paralysis. The early results were good in 16 cases, poor in 8, the late results were good in 10 cases, poor in 4 (Chart 1, i). Arthrodesis was combined with operations for restoration of function in the majority of cases in this group with tenoplasty on the muscles of the forearm in 4 cases, with tenoplasty on the flexor muscles of the elbow in 2 cases, with thumb checks in 3, with tendon transplants in 4, and with pronator resections in 3.

Arthrodesis was chosen as the means to procure position, because control of the position by muscle action was difficult and unreliable, tendon transplantation, on the other hand, was used in suitable cases of this type to procure extension of the fingers.

2 Correction by tenotomy and tenoplasty of wrist flexors was used in 21 cases of spasticity. This operation was combined with arthrodesis of the wrist in 2 cases, with thumb checks in 2 cases, with tendon transplantations in 2 cases, and with pronator resections in 3 cases.



Chart 2 Restoration of form Group B, pronation and supination contractures of wrist 1 Forearm pronation pronator resection 18 cases 2 Forearm supination supinator resection 3 cases 311 whole arm pronation Sever's operation 13 cases total 34 cases Combinations tendon plastic operations 5 cases thumb check operations 3 cases arthrodesis of wrist 3 cases, tendon transplantation operations 4 cases

Arthrodesis of the wrist was not added to the operations on soft structures when moderate flexion contracture was present or when only a few muscles, especially the flexor carpi ulnaris, were contracted. In these cases equilibrium of the wrist was likely to be restored without arthrodesis. The immediate results were good in 13 cases, poor in 8, the late results good in 7 cases, poor in 3 (Chart 1, ii).

3 Non paralytic wrist flexion contractures (Vollmann's contractures, congenital, arthritic, and traumatic contractures) were corrected by tenotomy and tenoplasty in 26 cases. The operation was combined with arthrodesis of the wrist in 4 cases, pronator resection in 2 cases, tendon transplantation in 2 cases, tendon graft in 1 case, and with a plastic operation on the thumb in 3 cases. The immediate results were good in 22 cases, poor in 4, the late results good in 8 cases, poor in 1 (Chart 1, iii).

*Group B Pronation and supination contractures of the wrist* There were 34 cases in this group.

1 Correction by pronator resection was used in 18 cases, the conditions treated being spastic paralysis and ischaemic contracture. The early results were good in 11 cases, poor in 7, the late results good in 6 cases, poor in 3 (Chart 2, i).

2 Correction of supinator contracture by section of the supinator brevis and biceps was done in 3 cases of spasticity. The result was good in 2 cases, poor in 1 (Chart 2, ii).

3 Whole arm pronation was corrected by Sever's operation, tenotomy of the subscapularis, coracobrachialis, and pectoralis tendons.

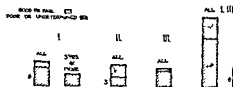


Chart 3 Restoration of form Group C contracture of fingers tendinous arthritic neuritic traumatic 1 Metacarpal osteotomies and resections 11 plastic operation on flexor extensors 11 finger plastic operations and capsulotomies. The cases may be divided into 1 ischaemic 10 spastic arthritic 4 neuritic 2. The total number of cases in this group was 21

in 13 cases the conditions treated being obstetrical palsy and spastic paralysis. The early results were good in 12 cases poor in 1 the late results good in 4 cases poor in 1 (Chart 2 III)

This operation although carried out at the shoulder is included in the series because of its effect upon supination of the forearm and hand. The operation was combined with tenoplasty in 5 cases with thumb check in 3 with arthrodesis of the wrist in 3 and with tendon transplantation in 4.

**Group C Contracture of the fingers.** There were 21 cases in this group including cases of tendinous arthritic neuritic and traumatic contracture. Not included in this group are those cases of finger contractures released by plastic operations on the flexor tendons of the wrist (Chart 1). In the group were 10 cases of ischaemic contracture 2 of spastic contracture 5 of arthritic and 3 of neuritic.

1 Metacarpal osteotomy and resection was done in 8 cases of advanced claw hand deformity. The immediate results were good in 6 cases, poor in 2 the late results good in 4 cases, poor in none (Chart 3 I).

Metacarpal osteotomy is especially useful in advanced arthritic claw hand with dislocation of the basal phalanx upon its metacarpal bone.

2 Plastic operations were performed on the finger flexors and extensors of the hand or fingers in 7 cases. The results were good in 3 cases poor in 4 (Chart 3, II).

3 Capsulotomy of the posterior capsule of the metacarpophalangeal joints was added to tenoplasty of the extensor in 6 cases of arthritic claw hand. The results were good in 5 cases poor in 1 (Chart 3 III).

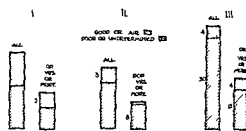


Chart 4 Restoration of form Group D dermatogenetic contractures 1 Local flaps 25 cases syndactylism 14 cases congenital contractures 3 cases scar contractures 6 cases 11 Shift flaps 11 cases 20 syndactylism 4 cases traumatic contractures 4 cases burns 9 cases congenital contractures 3 cases 111 Italian flap 34 cases burns 2 cases traumatic 3 cases syndactylism 4 cases others 2 cases. The total number of cases in this group was 70

**Group D Dermalogenetic contractures skin surgery.** There were 70 cases in this group, most of the cases being of syndactylism, burn and congenital contractures.

1 Local skin flaps were used in 25 cases. The methods of Didot, Tubby, and others were followed. There were 14 cases of syndactylism 3 of congenital contracture, and 6 of scar contractures. The results in this group were only fair the immediate result being good in 14 cases poor in 11, the late results good in 7 cases poor in 5 (Chart 4 I).

2 Shift flaps after the method of Picot were used in 20 cases 4 cases being of syndactylism, 4 of traumatic contracture, 9 of burns and 3 of congenital contracture. The results of this type of operation were much better than those of the former. There was less interference with primary wound healing and less tendency to recurrence. The immediate results were good in 15 cases, poor in 5 the late results good in 8 cases poor in 1 (Chart 4, II).

3 The Italian flap method was used in 34 cases burns, 25, traumatic contractures, 3 syndactylism 4 and other cases 2.

The development of the Italian pedunculated flap method constitutes one of the most gratifying chapters in the reconstruction work of the hand and fingers. We found its results fairly stable if prolonged after treatment and splinting followed the operation.

The immediate results were good in 30 cases, poor in 4 the late results good in 13 cases poor in 4 (Chart 4 III).

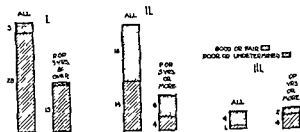


Chart 5 Restoration of function Group A, drop wrist and fingers 1, Stabilization arthrodesis infantile paralysis obstetrical paralysis ischaemic paralysis, congenital club hand etc 2 Mobilization tendon trans plantation—flexors to extensors for infantile paralysis, 7 cases spastic paralysis 16 cases others 7 cases Group B 3 Loss of supination Tubby's transposition of pronator radii teres Transposition of flexor carpi ulnaris Combinations tendon transplantation, 9 cases thumb plasties 5 cases elbow flexor plastic operations 9 cases etc Combinations arthrodesis—wrist 11 cases tendon plastic operations 4 cases etc

#### RESTORATION OF FUNCTION

##### Group A Drop wrist and drop fingers

1 Stability was restored by arthrodesis in 31 cases of infantile paralysis, obstetrical paralysis, ischaemic paralysis, congenital club-hand, etc Here are classified procedures which have for their primary object either stability or mobility of joints, or both, the restoration of form being a prerequisite Combined operations were tendon transplantation in 9 cases, plastic operations on the thumb in 5 cases, and tenoplasty of the elbow flexor in 9 cases The functional results in this group were favorable, though they represent the effect of combinations and not of a single operation The immediate results were good in 28 cases, poor in 3, the late results good in 13 cases, poor in 1 (Chart 5)

2 Mobilization by tendon transplantation The flexors of the wrist were transplanted to the extensors of the fingers in 30 cases The conditions were infantile paralysis, 7 cases, spastic paralysis, 16 cases, other conditions, 7 cases The operation was combined with arthrodesis of the wrist in 11 cases, tenoplasty in 4, etc The immediate results were good in 14 cases, poor in 16, the late results good in 4 cases, poor in 6 (Chart 5)

In general the late results of tendon transplantation were not as good as expected Causes of failure were errors in indications as well as errors in technique, the latter probably prevailing There are a number of technical

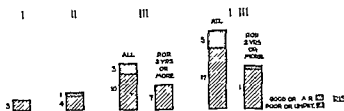


Chart 6 Restoration of function Group C tendon reconstruction traumatic ischaemic, inflammatory contractures 1 Sutures 3 cases 2 tendon grafts 5 cases 3 tendon plastic operations 14 cases total 22 cases

difficulties the necessity of leading the tendon through several fascial compartments facilitates the formation of adhesions The tendon must be immobilized for a long distance in order to obtain a straight line of pull The tendon sheath must be preserved or reconstructed and the suture must be mechanically accurate

##### Group B Tendon transplantation for loss of active supination

1 Tubby's method of transposing the pronator radii teres was used in 4 cases of spasticity The initial results were better than the late results (Chart 5) Mechanical inefficiency of the transposed muscle (pronator teres and flexor carpi radialis) seemed to be the principal cause of failure

2 Transplantation of the flexor carpi ulnaris was done in 4 cases of spasticity The flexor carpi ulnaris is led from the internal epicondyle obliquely over the dorsal surface of the forearm to the lower end of the radius The method is still on trial but the immediate results are promising (Chart 5, 11)

##### Group C Impairment of finger flexion

There were 15 cases in this group, including cases of traumatic, ischaemic, and inflammatory disabilities of the flexor tendons

1 Simple suture of tendons Although the group is small the result of simple sutures or plastic procedures was fairly satisfactory Failures were due to postoperative adhesions or deficiencies in the after-treatment On the whole the results were good mechanically and anatomically Functionally they depended largely upon the underlying pathological condition (Chart 6, 1)

2 Implantation of tendons was used in 6 cases of inflammatory and ischaemic con-

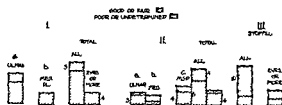


Chart 7 Restoration of function Group D Peripheral nerve surgery: Neurolysis a ulnar for delayed ulnar palsy 6 cases traumatic paralysis 4 cases b median and plexus for ischemic 1 case and traumatic 3 cases c Suture of ulnar median and musculospiral for ischemic paralysis 1 case traumatic paralysis 9 cases and others 2 cases d Stoeffel operation—median and ulnar 13 cases. The total number in this group was 35 cases

fracture with extensive scar formation. In 5 instances the peroneus longus was used for the implant and in one the palmaris longus (Chart 6 u).

It was the policy in cases of traumatic and inflammatory destruction of the flexor tendons of the fingers to carry out a painstaking resection of all scar tissue. A soft tissue bed was thereby obtained into which the implant was laid together with its natural gliding apparatus. The dissection was made well into the healthy tissue above and below the scarred region so that the suture would be laid in comparatively healthy surroundings. The results on the whole were satisfactory and remained so or improved with longer observation being good in 3 cases poor in 1.

**Group D Peripheral nerve surgery.** This group was composed of cases treated by neurolysis nerve suture and Stoeffel's operation.

1. **Neurolysis (ulnar median and plexus)** was used in 14 cases including 6 cases of late ulnar palsy, 7 of traumatic paralysis, 1 of ischemic paralysis. The results of ulnar neurolysis including the 6 cases of delayed ulnar palsy were good (7) good (3) poor. Those of neurolysis of the median nerve and plexus also gave good results (4) 1 with full return of function.

The total showed a ratio of 11:3, late results 4:0 (Chart 6 i).

2. **Nerve suture** was employed in 13 cases including 4 cases of ulnar nerve suture, 3 of median nerve and 6 of musculospiral nerve suture, 1 case of ischemic paralysis, 9 cases of traumatic paralysis, and 2 cases of other



Chart 8 Restoration of function Group D or E Thumb action deficiencies: a Inability to oppose and adduct infantile paralysis b ischemic paralysis traumatic paralysis burn contractures c Inability to extend and abduct, spastic paralysis. The total number of cases in this group was 42. Thumb flexor plastic operation was done in 23 cases. In this group combination operations were done as follows: tendon plastic operation on the forearm 4 cases flexor plastic operation at elbow 4 cases pronator resection 1 case. Of the thumb check operations: 19 cases combination operations were done as follows: tendon plastic operation on forearm 4 cases flexor plastic operation on elbow 4 cases pronator resection 3 cases tendon transplantation 2 cases.

conditions (Chart 7 u). Results of ulnar nerve suture were fair (3) 1. Those of the median nerve suture were poor (1) 1. The best results obtained were those of musculospiral nerve suture (4) 1.

3. **Stoeffel's operation** (selective resection of the median and ulnar nerves in spastic paralysis) was done in 13 cases (Chart 7 w). In general the results of Stoeffel's operation on the forearm were poor, the ratio of good to poor being immediate 3 to late 2:3. The reason for this lies largely in the difficulty of estimating the amount of nerve motor supply to be removed and in the difficulty of reeducation. The extensors are often extremely weak so that active muscle equilibrium is hard to obtain.

**Group E Thenar disability with lack of opposition and extension of the thumb.**

1. **Flexor plasty** for lack of opposition of thumb was done in 23 cases including cases of infantile paralysis with thenar palsy, ischemic contractures, peripheral paralysis.

To overcome this very great disability the long flexor of the thumb is split and the outer half is laid around the outer and posterior contour of the base of the first phalanx of the thumb. Acting as a guy rope together with the long flexor the contraction of the latter swings the thumb in opposition to the fingers. The operation proved highly dependable the results being immediate, 17 good, 6 poor, late, 9 good, 1 poor (Chart 8, i).

2 The thumb check operation for inability of extension and abduction of the thumb was done in 19 cases of spastic paralysis, the immediate results being 15 good, 4 poor, the late, 10 good, 3 poor

This method introduced by Mayer and Biesalski proved very useful in cases of spasticity in which extension and abduction of the thumb was too weak to prevent the latter from being caught under the fingers when the fist was closed. The operation is simply an anchorage of the extensor proprius of the index finger to the long extensor of the thumb to act as a check against flexion. Of the 19 cases operated upon 15 were successful and 4 were failures (Chart 8, 11)

#### AFTER-TREATMENT

A few words should be said about the after treatment because it constitutes a most important phase of the treatment and determines more than any other factor the ultimate outcome. The principle of the immediate after treatment was that of immobilizing the hand in the position of correction, or in cases of tendon transplantation or tenoplasty in the position of relaxation of the transplanted tendon. Active motion was started in cases of tendon transplantation after the seventh day and of tenoplasty or implant after the tenth day, appropriate

splints being worn from the moment of removal of the primary cast

When operations were combined, concessions had to be made to the one requiring the longer period of fixation, for instance, in cases of combination of arthrodesis with tendon transplantation. This necessitated, sometimes, considerable departure from the routine of the individual operation but we have noticed no evil effect of such necessary delay in instituting active or passive motion

#### MUSCLE TRAINING

Muscle drill and muscle training represent a higher degree of functional development. In our cases they had their due place in the more advanced stages of recovery. For this work a definite system was devised based upon the development of exact hand and finger movements with the use of standardized objects, as well as upon the development of speed and precision

In general, the earlier experiences on the merits of the operative methods have been corroborated by late observations. In some fields, such as tendon transplantation, selective nerve resection etc., the final results fell behind expectations. We feel that the results are encouraging enough to accord to orthopedic surgery of the hand and arm a much wider application than it now enjoys

## THE ORTHOPEDIC ASPECT OF LOW BACK PAIN IN CONNECTION WITH PELVIC DISORDERS<sup>1</sup>

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PAIN in the back is one of the most prevalent conditions encountered by the physician. It is as loosely diagnosed as rheumatism and equally badly managed. All too frequently the belladonna plaster or a prescription for aspirin or cinchophen is substituted for a painstaking examination. Even after the most careful examination we are occasionally at a loss as to the etiology. For some years I have endeavored to carry in my mind a little outline which I have found of great assistance. I think of backache as having its origin (1) in some abnormal condition in a distant organ in the thoracic, abdominal or pelvic cavities (2) in some organ or in the tissue lying contiguous to the spine, (3) in a disturbance of nerve trunks or plexus, (4) in diseases or disturbances in the spine itself or in the sacro iliac synchondrosis.

A number of years ago a patient came for examination complaining of severe low back pains. She stated that for several years she had had pain in her back especially upon standing, walking, lifting or repeated stooping. She had consulted many physicians but had never obtained permanent relief. She stated that she had been just examined by Dr. X who had told her that she had a severe tipping of the uterus that the uterus lay against her backbone and that the ovaries and tubes were behind the uterus also severely pressing against the back. He told her furthermore that in order to get complete relief she must have an operation, that he would shorten the round ligaments and that this would straighten everything.

My object in presenting this paper is to show that very little relation exists between pelvic infections and low back pains except in rare cases in which some of the sacral plexus of nerves are involved by more or less extensive generalized pelvic infection. Furthermore, I wish to show that there is little reason for the popular opinion among the laity and also with some men in the practice

that malpositions of pelvic organs give rise to much backache. The points I wish to make are (1) that only in comparatively few instances can low lumbar or sacro iliac pain be attributed to pelvic disorders *per se*, (2) that the nerve supply of the uterus and adnexa has a much higher origin than we generally believe (3) that upon careful examination a more rational cause can be found in most backache cases, (4) that the care of back pain cases in women as well as in men belongs in the realm of the orthopedic surgeon.

We must differentiate definitely between actual pain and local sensitiveness or tenderness. You as gynecologists know that many cases show marked pelvic tenderness upon a vaginal examination who do not have actual pain in the back. Furthermore, that the retroversion or retroflexion of the uterus even in the third degree does not bring the organ and its adnexa into direct contact with the spine nor do definite pressure symptoms usually exist.

A study of the nerve supply of the uterus brings to our attention the fact that the innervation for the most part comes from the pelvic plexus (sometimes called the inferior hypogastric) the ovarian plexus, and a few filaments from the sacral nerves. This pelvic plexus has its origin in the hypogastric which in turn originates from the aortic plexus and upper lumbar ganglion.

The ovarian plexus is derived from the renal plexus receiving some filaments from the aortic plexus. It will be remembered that the renal plexus comes from filaments of the solar plexus and the outer part of the semilunar ganglion. We see then that there is no logical reason for the transmission of pelvic pain into the lower lumbar or sacro iliac region.

Careful examination will show that there are other more plausible causes in the production of this common complaint. No one will deny that backache is more prevalent in women than in men. The spine and pelvis of

<sup>1</sup>Read before the Chicago Gynecological Soc. December 17, 1917. (Read and see p. 557.)

the male are built for the performance of heavy duty, standing, walking, and lifting. The ligamentous structures are more massive, being more fully developed by exercise and labor. The relation of the female pelvis to the sacrum and spine is entirely different, the size and shape of the pelvis is different. The posture line in the male is erect. The spine comes directly upon the sacrum designed to give strength and endurance. Compare that with the posture line of the female, that of gentle curves in the upper spine and the forward, almost lordosis curve in the lumbar spine drawn by artists along lines to represent grace and flexibility. Fashion and habit have been definite factors in producing anatomical lines, although the more graceful are prone to excessive curves and consequently deformity which in many instances means pain. There was that period in which tight fitting apparel produced a narrow waist line and a consequent displacement of most of the abdominal viscera into the lower abdomen and pelvis. Then came the period when it was fashionable to droop the shoulders and to counteract that a protrusion of the abdomen, which eventually may result in a pendulous abdomen, thus causing a lordosis deformity and an abnormal forward tilting of the pelvis. This posture brings about definite deformity and with it the ultimate cause for backache. The child bearing function brings with it certain definite changes and distortions of the pelvic bones. The symphysis is separated in many instances during the period of gestation and delivery. The sacro iliac synchondrosis spreads, the ligaments which have as their function the retention of the normal relationship of the articulations become relaxed. Often these distortions are not corrected, an instability of the sacro iliac and even a slipping of the joints results.

We expect too much from nature. Our patients are permitted after 10 days to be up and about on the presumption that the relaxation which has taken place over a period of months has corrected itself. We can readily imagine what permanent changes must take place after eight or ten pregnancies in that number of years. During my lying in service our patients after delivery insisted on

having very firm binders applied, saying they wished to avoid "high stomachs." This commonplace expression of vanity had a more rational basis, that of holding the pelvic girdle firmly to assist in the rapid restoration of the normal relation of the pelvis.

The true cause of low back pain is prevalent in women as well as men. The same osteo arthritic changes obtain. Osteospondylitis with its resultant bone changes and its pains and aches is responsible for most of the disability. This inflammatory process coupled with well known tilting or "torsion" of the fifth lumbar vertebra on the sacrum spells incapacity. Even more distressing is the acute pain which comes from a subluxation or slipping of the sacro iliacs. You have all seen this type. The patient steps off the curb unexpectedly or suddenly misses a step while going upstairs, or turns suddenly and something happens in the lower spine. Immediately pain results. The patient cannot walk or if she walks at all it is in position with a formed stoop or possibly in a stooped position leaning off to one side or the other.

There are other traumatic conditions which we all see frequently which have their origin from an unusual day's work, standing, stooping, washing, etc.

Postural deformities from bad posture habits, infantile paralysis, rickets, tuberculosis, and a fracture involving the spine must be mentioned.

We often overlook deformities of the lower extremities, especially those of the feet. Flatfoot deformity means walking with feet in eversion and a change in hips and pelvis. As etiological factors we can enumerate the various foci of infection—teeth, tonsils, sinuses, kidney and bladder involvements and occasionally pelvic infections. Trauma plays no small part in the localization of these foci. With this in view, does not the back ache case belong in the realm of the orthopedic surgeon rather than that of the gynecologist?

The management, then, does not often call for the removal of tubes, ovaries, or uterus nor can conditions often be relieved by the shortening of the round ligaments nor the anterior fixation operations. It demands a



removal of the cause primarily, then an improvement of posture a change of habit dress and proper adjustment of the various fashions or whims which make for deformed spines and pelvis. These patients need proper plaster casts braces or corset braces to correct these deformities and hold the body in proper position until the inflammatory process has subsided. After that a correction of modes of living and then the *development of musculature and ligamentous structure* by suitable rational exercise so that the skeleton may be properly held in position. In the subacute or acute strains absolute rest with immobilization is indicated. Women who bear children need our special care and attention a reasonable length of time must elapse before such patients should be permitted to be up and about at their daily routine. Then and only then will we avoid the disfiguring and painful deformities so often seen in our comparatively young women

only then will we see less of the woman with wide hips and the pendulous abdomen the woman of thirty eight with the characteristic complaints and deformities of a grand mother of sixty

#### SUMMARY

In my summary then permit me to emphasize

1 That backache and deformity are due *only in rare instances to disease of the pelvic organs*

2 That a careful examination will reveal other causes of pain and will prevent the numerous unnecessary often unsexing operations all too frequently performed

3 That a removal of the cause and proper supporting measures will often give complete relief

4 That the care of backache in women as well as in men is the responsibility of the orthopedist and not the gynecological surgeon

## A CONTRIBUTION TO THE STUDY OF LOW BACK PAIN

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**A** FREQUENT and perplexing problem is the low back strain. In certain cases the patient will get relief in a few days regardless of treatment while in others treatment is followed by slow convalescence or chronic low back pain inhibiting active work. Because of some early failures in the treatment of this condition I was stimulated to further investigation of the problem.

Causes for low back pain may be listed under the following<sup>1</sup> (1) trauma including sprains, strains, fractures, and dislocations, (2) faulty position with relaxed ligaments and muscles, (3) diseases of the spine and sacro iliac joint, (4) intra abdominal and pelvic pathology, (5) skeletal malformation. It is not necessary to dwell at large on these various causes as they have been so well discussed by numerous other writers. It is the purpose of this paper to lay particular emphasis on the muscular mechanism that plays a considerable role in low back pain, especially when it is related to injury. A large number of patients give a history of having lifted something beyond their capacity or of having an unexpected load suddenly thrown upon them while lifting. In another group of cases the patient gives a history of carrying on some work in a cramped or faulty position and of working at a mechanical disadvantage. Still others have assumed a faulty attitude because of intra abdominal or pelvic disease or an old injury or disease of the spine, sacro iliac joint, or hip joint. Any of these conditions may lead to an excessive sudden or a prolonged load upon a certain group of muscles with the result that the patient complains of low back pain, most severe when he attempts to straighten up from the stooped over position or when he arises from the sitting position.

Those muscles which play an important part in keeping man in the erect position are prone to considerable strain when he bends or stoops or attempts to lift a load while in this flexed position. There are two important

muscle groups in this category, namely the gluteal group and the sacrospinalis group.

The gluteal group, between the pelvis and the upper extremity of the femur, is probably the one most important group since in bending over the greatest axis of motion is through the hip joint. A special study of this group of muscles was made, both clinically and in the laboratory.

The textbooks in anatomy list only the gluteus maximus as an extensor of the hip. They make no mention of the gluteus medius as an extensor of the hip, simply calling its action, abduction and internal rotation. The problem of determining the function of the gluteal muscles was undertaken. The mechanical device shown in Figure 14 was constructed. The pelvis with the intact hip joint and femur was clamped to the table. The femur was blocked posteriorly so that it could only be brought back to the normal standing position. A cord was attached to the insertion of the muscle and then directed toward the origin of the muscle. The cord instead of being attached to the origin, was run through a hole in the bone at that point and over a pulley across the table where a weight was attached to the end of the cord. The weight kept the cord at constant tension and a needle was so fastened in the cord as to register all movements. When the femur was flexed on the pelvis, the needle indicator held against a chart moved through a distance equal to the elongation of the relaxed muscle. Then on bringing the femur back to the normal standing position the contraction distance was noted. To get the action of groups of muscle fibers in the various parts of the muscle the cord was attached to a number of screws placed at the muscle insertion and the cord permitted to run through a number of holes placed over the origin.

The function of the gluteus maximus was first determined, the cord extending from eight different points of origin to four different points of insertion (Figs. 3 and 4). From the

<sup>1</sup>Classification of B. Hington

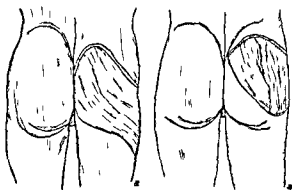


Fig. 1 (left) Gluteus maximus muscle

Fig. 2 Gluteus medius muscle

chart (Fig. 5) the following conclusions were drawn

1 All portions of the gluteus maximus muscle are important in extending the thigh

2 The muscle fibers attached to the acetabulum recorded considerable more contractile distance than those attached to the ilium

The gluteus medius muscle was then worked out in a similar manner, the cord extending from fourteen different points of origin to four different points of insertion (Figs. 3 and 4). From the chart (Fig. 6) the following conclusions were drawn

1 The gluteus medius is an important extensor of the thigh although it is not recorded as such in anatomy textbooks

2 Those fibers attached to the outer half of the ilium and to the upper part of the greater trochanter are the most pronounced extensor fibers. The last fibers mentioned above record almost the same contractile distance as the maximum contraction fibers of the gluteus maximus

The gluteus minimus was then worked out in a similar manner, the cord extending from twelve points of origin to three points of insertion (Figs. 3 and 4). From the chart (Fig. 7) the following conclusions were drawn

1 While in extension some of its fibers probably slightly aid in extension

2 Most of its fibers aid in flexion when the hip joint is the least bit flexed

The diagrams in Figures 8 to 13 inclusive are tracings from photographs and show the origin and insertion of the gluteus maximus, medius and minimus, the lines of traction

and their relation to the axis of rotation both in the extended and flexed positions. The lines of traction of both the gluteus maximus and medius in the extended and flexed positions are posterior to the axis of rotation thereby resulting in the extension function of these muscles. The lines of traction of the gluteus minimus are both anterior and posterior to the axis of rotation and vary in the extended and flexed positions.

With the above knowledge of the functions of the gluteus maximus and medius as extensors of the hip, particular emphasis was placed on the examination of these muscles in all cases with histories of strain injury or pain in the lower back region on whom marked tenderness could be found if pressure was made over the gluteus maximus and medius muscles. In a considerable number of cases tenderness could be found only when the patient was asked to bend over and then with both thumbs exerting deep pressure over the glutei the patient assumed the erect position. Such palpation should include the entire origin of these muscles and the body of the muscles over the ilium.

Myositis is in itself and particularly gluteal myositis seldom receives attention in the many articles dealing with low back pain. I believe the condition is frequently present in those who have had back strain who work at a mechanical disadvantage or whose equilibrium has been disturbed.

Every joint depends for support against continuous strain on the ligaments but for all motion on the muscles. It is the muscle with its fascial attachments and tendons that assumes the rôle of the first protective barrier in movement. In the region of the sacroiliac joint although large bundles of muscular fibers are not present, yet their fascia form a network over the sacroiliac joint and thus fascial muscular mechanism must in many instances receive the primary and only injury. Notwithstanding the fact that a freely movable (diarthrodial) joint depends for its integrity in motion primarily on its muscle mechanism and when the muscles are thrown off guard or do not coordinate on the ligaments, yet in many so-called sprained ankles the pathological change

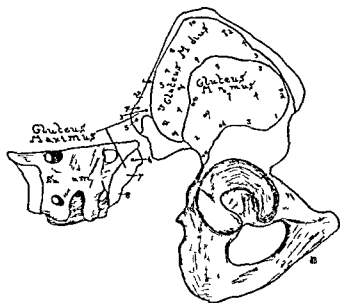


Fig 3 Showing origin of gluteus maximus medius and minimus on ilium and sacrum. Numbers correspond to those on charts in Figures 5 to 7

is probably not in the ligaments but in the surrounding tendons and the tendon sheaths which have sustained the first shock. The lateral and medial ligaments of a freely movable joint such as the ankle may be compared to the sacro iliac ligaments and the tendons to the muscle and fascia over and around the sacro iliac joint. The muscles and fascia around this joint must in many instances receive the strain of the axis of rotation through the hip joint. This is true in cases in which one is attempting to lift a load beyond his capacity. A sudden or unexpected load will also throw the load on the muscle mechanism.

Man in the process of stooping over to pick up an object flexes the pelvis on the thigh. He goes through the same flexion movement when he seats himself on a chair. To get up from the sitting position or to straighten up from a stooped over position, he uses more than any others the gluteal muscles. It is these muscles that are the pulling force against the load when the center of gravity has been placed in front of the perpendicular axis.

It is not the purpose of this paper to condemn the diagnosis of sacro iliac disease. This condition probably exists, but not as frequently as the diagnosis is made. Sacro iliac disease has received wide attention and the diagnosis has become so popular that

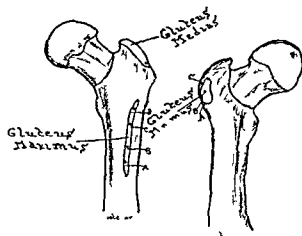


Fig 4 Showing insertion of gluteus maximus medius and minimus on femur. Letters correspond to those on charts in Figures 5 to 7

many other equally severe conditions have been overlooked. I believe the sacro iliac joint is a potential joint inasmuch as it has a synovial membrane and an articular cartilage. It probably possesses no normal movements, yet it may assume abnormal ones which may possibly result in subluxation. Contrary to the opinion of some previous writers the sacrospinalis muscle and the gluteal muscles are not antagonistic muscles tending to separate the sacrum and ilium. The sacrospinalis with its attachments to the sacrum and ilium and the glutei with their origins on both the sacrum and ilium tend to support rather than separate the joint. It would seem that more injuries would be in the lumbar region. This is due to the fact that above the lumbar vertebrae, there is the support of ribs and their muscles for the vertebral column. In the lumbar region the ribs are absent and there is no lateral bony support for the vertebral column. Below the lumbar region there is the bony pelvis. These joints being in the lumbar region, with less support, and more freely movable, are probably subject to more frequent injury from strains than the sacro iliac joint. Though the lumbar joints are frequently the seat of injury, the trauma and injury to the muscles which protect the joints must not be forgotten. The sacrospinalis muscle must receive some injury in most lumbar strains and in some instances be the only lesion.

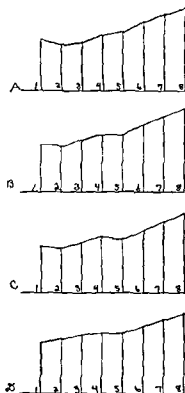


Fig 5 Chart showing degrees of extension of various parts of the gluteus maximus muscle. The needle indicator always moved upward from the base line proving the muscle to be an extensor of the hip joint

In the dissecting room the appearance of the position of the sacrospinalis muscle led me to believe that this muscle bridging over the lumbar region between the lower ribs and pelvis was subject to considerable strain. To prove this the apparatus shown in Figure 15 was used in the examination of the hypothesis.

This apparatus is similar to that described in the experiment with the gluteal muscles. In addition, the flexible spinal column is represented by a long spring made of No 8 spring steel wire. The spring is flexible and it can be made to closely simulate the movements of the spinal column. The long upper transverse wires which have been screwed onto the spring represent the ribs. The shorter lower transverse wires represent the transverse processes of the lumbar vertebrae.

The sacrospinalis muscle with its various component parts is rather complicated in its structure and attachments. It is placed on

either side of the vertebral column extending from the sacral to the cervical regions (Fig 16). Below it is attached to the sacrum, ilium spines of sacrum lumbar and thoracic vertebrae, supraspinous ligaments and sacro iliac ligaments. Above its various component parts are attached to the ribs and transverse processes of the vertebrae.

A cord was extended from the ribs and transverse processes to small holes in the upper part of the ilium and to a pulley across the table where a weight was attached. This is along the line of traction of the muscle. A wire indicator attached to the cord moved across the chart. Although the sacrospinalis muscle was not worked out in detail as with the gluteal muscles yet it was definitely demonstrated that the sacrospinalis is an important extensor muscle of the vertebral column and due probably to its above described position is subject to considerable strain. All patients with low back pain were examined for injury of this muscle.

The pathology found in traumatic myositis is rather obscure. What occurs is probably a laceration of muscle fibers and of fascia varying degrees of hemorrhage and malposition of structures. It is rather difficult to get material for scientific investigation.

If the patient has a focus of infection at the time of injury it is possible that a secondary infection myositis will present itself. I have had a number of cases in which the condition did not improve as rapidly as might be expected until foci of infection had been removed, when rapid improvement followed.

The recognition of low back strain is not easy. The triumvirate in the diagnosis of conditions of the low back region associated with trauma are myositis (of the gluteal and sacrospinalis muscles), lumbosacral strains and sacro iliac strains. However we must always be on the alert for the detection of fractures and dislocations, osteoarthritis, static backache, congenital anomalies, sacro iliac disease, sciatica, tuberculosis, syphilis, primary or metastatic neoplasm, toxemia and focal infection.

A definite routine should be followed in the examination of every case of back injury.

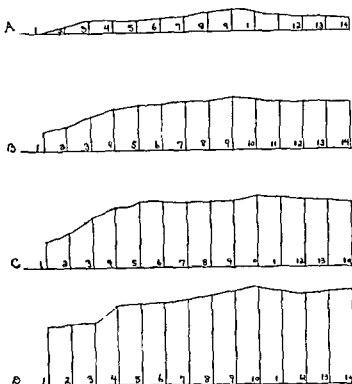


Fig 6 Chart showing degrees of extension of various parts of gluteus medius muscle. The needle indicator always moved upward from the base line proving the muscle to be an extensor of the hip joint

It is helpful to get a history of just how the injury occurred and to what extent of straining the back has been subjected. It is probable that many of the cases of both mild and severe trauma result in muscular injuries. The sacro iliac cases usually follow severe trauma, the lumbosacral cases do not.

Palpation for tenderness should be complete. It is well to begin at some definite point and proceed in some definite systematic manner. I have found the posterior superior spine most helpful as a bony landmark and beginning at this point palpate for tenderness over the gluteus maximus and medius muscles (Figs 1 and 2), and the sacrospinalis muscles (Fig 16). I then palpate for tenderness over the lumbar vertebrae and sacrum, and lay particular emphasis on the lumbosacral joint which is just medial and above the posterior superior spines. Attention must then be directed to the sacro iliac ligaments, ilio lumbar ligaments, and the sacro iliac joint.

The greatest amount of information is received from palpation for motion tenderness

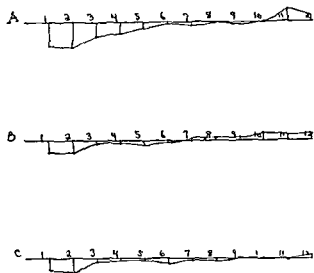


Fig 7 Chart showing degrees of motion of the gluteus minimus muscle. The needle indicator tended to move downward or remained stationary proving that the muscle was a weak flexor of the hip joint when hip was in flexed position

or what I prefer to call function tenderness. It is helpful to divide motion into the three different positions standing, sitting, and lying.

1 Motion standing. I palpate for function tenderness by deep pressure over the gluteal muscles as the patient straightens up from the stooped over position. If there is a gluteal myositis or possible traumatic neuritis or bursitis, the patient will complain of much more pain than when asked to straighten up without applied pressure on the gluteal muscles. Cases of gluteal myositis may result in so much spasm as to simulate either sacro iliac or lumbosacral strain. Injuries of the sacrospinalis muscle will show rigidity of the spine and function tenderness on bending. The lumbar region will be held rigid by muscle spasm if the condition is lumbosacral, flexion will take place at the hips, upper lumbar spine and dorsal regions. In sacro iliac conditions the patient is apt to bend forward by flexion of the lumbar spine.

2 Motion sitting. A patient with a gluteal myositis will complain of moderate pain upon assuming the sitting position, more marked however upon arising from the sitting position because of the functioning gluteus maximus and medius muscles. In a case of myositis of the sacrospinalis muscle the spine is held rigid and there is function



Fig. 8



Fig. 9



Fig. 10



Fig. 11



Fig. 12

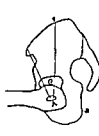


Fig. 13

Fig. 9 Gluteus maximus with hip extended shows extension by entire muscle. *EF* is the origin of gluteus maximus. *I* and *I'* functional insertions. *F* *I* and *F* *I* are lines of traction. *C* is center of rotation.

Fig. 10 Gluteus medius with hip extended shows extension by entire muscle. *EF* is origin of gluteus medius. *I* is functional insertion. *E* *I* and *F* *I* are lines of traction. *C* is center of rotation.

Fig. 11 Gluteus minimus with hip extended shows that extensor and flexor fibers probably equal each other. *EF* is origin of gluteus minimus. *A* is functional insertion. *E* *I* and *F* *I* are lines of traction. *C* is center of rotation.

Fig. 12 Gluteus maximus with hip flexed shows ex-

tension by entire muscle. *EF* is origin of gluteus maximus. *A* is functional insertion. *C* *I* and *F* *A* are lines of traction. *C* is center of rotation. *A* is anatomical insertion.

Fig. 13 Gluteus medius with hip flexed shows extension by entire muscle except for a few anterior fibers which apparently do not act as extensors or flexors. *EF* is origin of gluteus medius. *I* is functional insertion. *E* *A* and *F* *I* are lines of traction. *C* is center of rotation.

Fig. 14 Gluteus minimus with hip flexed shows flexion by greater part of muscle, a few fibers are apparent extensors. *A* *F* is origin of gluteus minimus. *A* is functional insertion. *C* *I* and *F* *I* are lines of traction. *C* is center of rotation.

tenderness just as in the standing position. In sacro iliac conditions it is quite remarkable how freely a patient may bend forward from the sitting position. In lumbosacral conditions the attempt to flex the spine while in the sitting position is just as limited as while in the standing position.

3 Motion lying. This may be divided into flexing the thigh with the knee flexed and with the knee extended. Gluteal myositis may give pain when the leg is raised in the flexed and straight position and particularly when the hip is brought back into extension. This procedure may or may not result in pain when the sacrospinalis muscle has been injured. With the knee flexed muscle leverage on the pelvis is eliminated to some

extent and sacro iliac conditions frequently are free from pain but in lumbosacral conditions pain is usually present. With the leg straight flexing the hip joint gives rise to pain in both sacro iliac and lumbosacral conditions. This examination should be done with one hand under the lumbar spine. If pain is brought on early in the act of straight leg raising that is before the lumbar spine begins to move the appearance of pain is in favor of sacro iliac disease. If there is no pain until the lumbar spine begins to move evidence is in favor of lumbosacral disease although both sacro iliac and lumbosacral disease may give rise to pain at this stage of

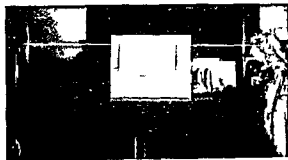


Fig. 14 Apparatus used in the experiment on gluteal muscle



Fig. 15 Apparatus used in the experiment on sacrospinalis muscle

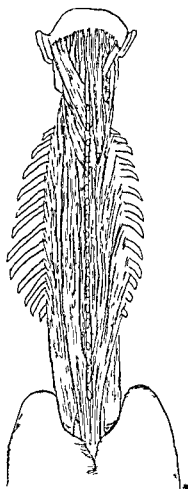


Fig 16 Sacrospinalis muscle

straight leg raising. The conditions on the two sides must be compared.

Compression of the iliac crests by placing the injured side on the table and pressing on the other iliac crest with the body weight should be done in all low back cases for evidence of sacro iliac disease and fractures.

Probably no examination is complete without the X ray and really no criticism should follow its extensive use. However, the X ray is usually essential only in the more severe types of injury or those in which convalescence is slow and a check up on the condition of the bone is essential.

Less emphasis should be placed on spinal anomalies and abnormal outlines, especially from the patient's standpoint, when they have no bearing on the treatment of the injury. Osgood reports that 50 per cent of the plates taken at the Massachusetts General Hospital for various troubles did not show normal outlines of the back region.

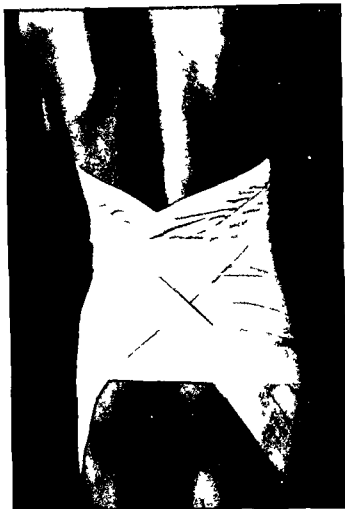


Fig 17 Correct strapping for gluteal myositis. The superficial diagonal strips indicate direction of deeper strips.

The treatment of gluteal myositis is correct strapping of the gluteal muscle, thereby attempting to give some protection to the muscle, to be supplemented by baking and massage. After having made the diagnosis, the gluteal region is strapped as shown in Figure 17. The principle is to extend the adhesive tape from well up on one lumbar region, diagonally down and across to the lateral border of the opposite thigh over the region of the trochanters. These strips tend to follow the line of traction. A few horizontal strips of adhesive are placed across the gluteal region and the lumbar region. If the sacrospinalis muscles show evidence of injury, the transverse adhesive strips must begin just above the level of the trochanters and extend up as high as the lower ribs. Long, wide, diagonal strips crossing over the lumbosacral junction give additional support.



After the patient has been correctly strapped he is asked to take a hot sitz bath 2 or 3 nights later at which time he is to remove the adhesive. The hot bath not only serves as a means for applying heat to an injured region and relaxing muscular spasm but also serves to make more easy the removal of the adhesive. The morning following the removal of the adhesive the patient is asked to return to the office where he is put under a cradle baking machine for 15 to 30 minutes. Following this the gluteal muscles and sacro-pinalis muscles are massaged. The massage must not be too vigorous yet it should be sufficient to cause some discomfort to the patient. It is rather striking how patients will at times arise from the table remarking how much better they feel. The patient is then strapped as before except less adhesive support is used. The patient is asked to repeat the bath two or three nights later remove the adhesive and return the next morning for baking and massage. In many of the patients the condition will have cleared up by this time while in others it may or may not be necessary to apply more adhesive support and to continue baking and massage. It all depends upon the severity of the case.

It is not in the scope of this paper to discuss in detail the treatment of all low back cases. The treatment of sacro iliac and lumbo sacral strains has been well covered in many other papers. Either condition demands all the possible immobilization with either strapping with adhesive various types of corsets or belts or plaster of paris jackets depending on the chronicity and severity of the case. The essential factor in providing a protective mechanism for the sacro iliac joint is to be sure that the pressure is exerted over the level of the trochanters of the thigh. Pressure

on the iliac crests tends to separate rather than oppose joint surfaces and to strain the ligaments rather than offer protection. The lumbosacral strain should secure support extending from the trochanters up to and beyond the lower border of the ribs. Both of these conditions should be supplemented by baking and massage.

The strapping if correctly applied tends to support and splint the injured muscles. In many of these low back strains whether an acute or chronic condition there have been strains or tears of the muscles their aponeuroses fascial attachments or ligaments. As a protective response and as a result of traumatic irritation the injury is followed by muscular spasm. This muscular spasm of injured tissue may result in malposition of muscle fasciculae fascia aponeurosis or ligaments which condition is crippling and painful. It is this type of case which responds to the treatment of the various cults. It can do little harm to attempt by a little massage or manipulation to effect a restoration of normal relations. We shall often be rewarded by a surprising sudden relief of symptoms and a relaxation of the originally protective and subsequently locking muscle spasm.

The baking is a valuable adjuvant relieves pain relaxes muscular spasm and increases the blood supply to an injured area.

#### SUMMARY

The gluteus maximus and medius muscles are extensors of the hip. This function of the gluteus medius is not described in anatomy textbooks.

Traumatic myositis of the gluteus maximus medius, and sacrospinalis muscles is a frequent condition.

Correct strapping supplemented by baking and massage will relieve the condition.

A HUMAN OVUM APPROXIMATELY NINETEEN DAYS OLD<sup>1</sup>

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**E**XACTLY fifty human ova less than 3 weeks old have been described more or less thoroughly during the last five decades. This means that the series of young human ova is far from complete and because of the inadequacy of our understanding of the early stages of development, a detailed description of all young ova is justifiable.

The ovum here described presents certain peculiarities in growth which have not previously been emphasized. It was obtained by Dr. D. W. Day of Rockford, Illinois, from a decidual cast expelled on October 31, 1918. The patient had had four spontaneous full term labors and had never had any miscarriages. Her menses had always been regular and recurred every 28 days. The menstrual period which began on August 18, 1918, was unusual because the flow was exceptionally profuse. In September the flow was expected on the fifteenth, appeared on the sixteenth and lasted only a few hours. On October 2, the patient was overcome by illuminating gas from which she recovered. On October 20, she became ill with influenza. On October 30, bleeding from the uterus occurred and the decidual cast was expelled spontaneously, 73 days after the last normal menstrual period and 44 days after the slight flow in September. The development of the ovum, however, indicates that it belongs to a group of ova with much shorter menstrual ages, as will be proved in the discussion on age. The cast was placed in 10 per cent formalin, 3½ hours after it had been expelled and was received on November 5, 1918. It is designated as H518 in the Embryological Collection of the Department of Anatomy, the University of Chicago.

## GROSS SPECIMEN

The cast which was pear shaped and measured 46 by 33 by 7 millimeters, was opened and the implantation site was photographed (Fig. 1). The cervical end of the cast

was easily distinguishable from the part which had been in the fundus of the uterus. Near the junction of these two distinct portions was an intact oval elevation which protruded into the uterine lumen. This elevation, which contained the ovum, measured about 9.4 millimeters in length, 7.3 millimeters in width, and 3 millimeters in height and the entire decidua at this site was 6.3 millimeters high. One spot in the elevation appeared more translucent than the surrounding tissue. As will be described later, this represented the point of entrance of the fertilized ovum. The surface of the decidua vera was furrowed.

## DECIDUA

Decidua is defined as uterine mucosa in the presence of pregnancy. We distinguish four types, namely, (1) decidua basalis which is that part on which the ovum rests and from which the ovum receives most of its nourishment, (2) decidua marginalis which surrounds the ovum equatorially, (3) decidua capsularis which forms the roof of the implantation cavity, and (4) decidua vera which is at a distance from the ovum.

*Decidua basalis.* The portion of the decidua basalis which immediately borders on the implantation cavity differs from the remainder of the basalis. It is separated from the implantation cavity by an almost continuous layer of fibrinoid<sup>2</sup> and is known in the literature by a variety of names but we shall call it the penetration zone and describe it with the trophoblast.

The decidual change which is found in early ova is very variable. In our specimen, the cells below the penetration zone show the typical decidual change. They are essentially large, polygonal, pale cells with large ovoid nuclei but some cells are round or spindle-

<sup>1</sup> Many writers use the term fibrin to designate both fibrin and fibrinoid. However as Grosser points out the term fibrin should be used only for the coagulum which arises from blood lymph or tissue juice. On the other hand fibrinoid arises chiefly from trophoblast but also from degenerated maternal tissue.



Fig 1 Photograph showing decidual cast opened  
a fundal end b cervical end c ovum d operculum

shaped. Scattered throughout the basalis are leucocytes. The glands in the basalis are narrow and run obliquely. Near the ovum they are almost parallel with the long axis of the implantation cavity (Figs 2 and 8). Most of the glands resemble those seen in the early premenstrual phase. Only an occasional gland shows the typical 'saw toothed' change of pregnancy, the so called pregnancy gland of Opitz. Nearly all the glands appear empty and but few of them show marked secretory activity. In most places the epithelial cells of the glands are cuboidal; they have granular protoplasm and they contain large pale nuclei. The total number of glands is strikingly small.

*Decidua marginalis.* The marginalis is similar to the basalis but the decidual changes

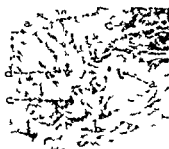


Fig 4 Invasion of decidua by plasmodium a Plasmodium b penetration zone of decidua basal s c fibrinoid d pigment

except very near the implantation cavity are not so pronounced.

The blood vessels in the decidua beneath and to the sides of the implantation cavity are numerous and consist chiefly of veins (Figs 2 and 5). Almost all the veins are dilated and contain free blood or fibrin or both. Most of the arteries are narrow and spiral shaped and contain very little blood. The walls of most of the veins consist of a layer of endothelium and an outer thin layer of connective tissue. The arteries on the other hand have not only an endothelial but also a well defined musculo fibrous layer.

There are many communications between the implantation cavity and maternal veins. A very careful study was made to find arterioles which open into the implantation



Fig 2 Photograph showing general view of ovum  
a Chorion laeve d chorion frondosum e blood in implantation cavity d implantation cavity or inter villous space e decidua basalis f decidua capsularis g gland h vein j curved vein



Fig 3 Photograph of drawing showing cytotrophoblast plasmodium and transition stages a Cytotrophoblast b plasmodium c brush border d transition stage. In this photograph the transition stages are particularly well illustrated.

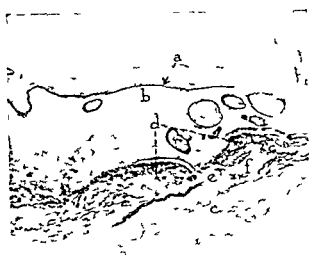


Fig 5 Photograph showing invasion of blood vessel by plasmodium a Chorionic vesicle b intervillous space c decidua basalis d fibrinoid e vein f plasmodium

cavity and while some arterioles were found coming close to the implantation chamber, none were found actually to communicate with it. We can, therefore, say definitely that large arterioles do not enter the intervillous space even at this early stage.

Immediately adjacent to the side of the implantation cavity are glands and veins curved like arcs which correspond with the curve of the implantation cavity (Fig 2). These curves are undoubtedly due to pressure of the growing ovum. The glands resist invasion of the plasmodium in contrast to the veins which are very susceptible to invasion by plasmodium.

**Decidua capsularis** The structure of the capsularis is hard to distinguish in most areas but in general the tissue consists of degenerated decidual cells with fibrinoid, blood vessels, a moderate number of red blood cells, many leucocytes, pigment and vacuoles scattered throughout. The nearer the implantation cavity the more necrotic is the tissue of the decidua capsularis the more deeply it stains and the more fibrinoid it contains. Most of the capsularis has no epithelial covering and in our specimen no glands were seen anywhere. In a few areas the capsularis is invaded by plasmodial masses coming from the implantation cavity. In one place, a thin strand of plasmodium is contiguous with the free end of the endothelium of a blood capillary (Fig 6).

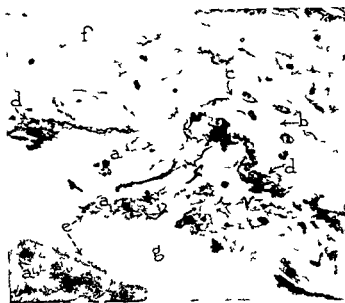


Fig 6 Photograph showing plasmodium in contact with maternal endothelium a Plasmodium b endothelium of maternal capillary c point of contact d fibrinoid e brush border f decidua capsularis g intervillous space

**Decidua vera** The decidua vera contains numerous glands resembling those of the premenstrual phase and abundant arteries and veins.

#### CHORIONIC VESICLE, VILLI, AND IMPLANTATION CAVITY

The following is a list of the measurements of our ovum. All the measurements are maximum ones and they are given in the following order: (a) the measurement parallel with the long axis of the uterus, (b) the



Fig 7 Photograph showing operculum deciduae a Decidua capsularis b operculum deciduae c plasmodium d piece of chorionic ectoderm e intervillous space



Fig 8 Photograph showing body stalk and amnion  
a Chorionic vesicle b implantation cavity c body stalk d amnion e trophoblast f gland

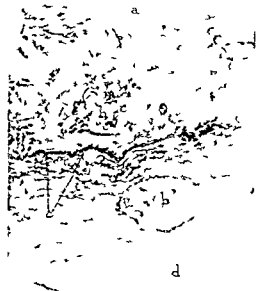


Fig 9 Photograph showing plasmotome in blood vessel and in intervillous space a Intervillous space b plasmotome c fibrinoid d decidua basalis

measurement perpendicular to the long axis of the uterus and (c) the measurement perpendicular to the mucous membrane

1 The ovum including the decidua capsularis as a gross specimen in formalin measured 9.4 by 7.3 by 3.0 millimeters and in the stained sections 8.37 by 6.44 by 2.67 millimeters

2 The implantation cavity in the stained sections measured 6.23 by 5.79 by 2.5 millimeters

3 The ovum with the definitive villi in the stained sections measured 4.72 by 5.41 by 2.23 millimeters

4 The ovum exclusive of villi in the stained sections measured 4.08 by 4.21 by 1.57 millimeters

5 The embryonic disk (estimated) in the stained sections measured 0.15 by 0.13 millimeters

6 The yolk sac in the stained sections measured 0.64 by 0.53 by 0.43 millimeters

The amount of shrinkage in the ovum was only 11 per cent, an unusually small amount and because of this the ovum appears to be relatively large in comparison to the stage of development it represents

From the surface of the chorionic vesicle (or blastocyst) which is directed toward the decidua basalis numerous well-developed villi arise whereas on the opposite surface there are comparatively few villi (Fig 2). There is therefore a definite differentiation into a chorion frondosum and a chorion laeve. Perhaps this is correlated with a superficial implantation. Some of the villi show budding but the buds themselves do not subdivide.

There is very little magma, the chorionic mesoderm being largely confined to the wall of the blastocyst where it consists of scattered spindle cells. Blood vessel anlagen are seen in the mesoderm of the chorionic vesicle and in a few of the larger villi.

The body stalk, which is a thickening of mesoderm, is situated in the chorionic vesicle basally but eccentrically. The allantoic duct, which consists of simple cuboidal epithelium, extends but a short distance into the body stalk.

In most places the chorionic ectoderm consists of two layers, an inner cytotrophoblast or pre-Langhans layer and an outer syncytial layer. The protoplasm of the former is well differentiated into individual cells and

the nuclei are large, pale, and distributed with some degree of regularity. The outer layer varies considerably in thickness and has elongated and dark staining nuclei which lie parallel to the surface. Many villi are covered with only one layer of ectoderm and this is usually the syncytial layer. On the tips of some villi the ectoderm is heaped up into a large mass of cytotrophoblast by means of which the villi are occasionally attached to the decidua basalis. There is much trophoblast between the villi and the walls of the implantation chamber (intervillous space). The latter is ovoid in shape and is confined to the decidua compacta. While there is considerable blood in some parts of the implantation cavity (Fig. 2), the latter is by no means filled with formed blood elements, nearly all of which are in a state of good preservation.

Nearly all along the border of the implantation cavity, but mostly at the basalis is an abundant homogeneous or striped, hyaline-like layer of fibrinoid (Figs. 2, 4, 5, 9). It is essentially a rough boundary line between normal fetal and fairly normal maternal tissue but in a number of places, fibrinoid is seen not only within plasmodium but also on the fetal side of some plasmodial masses (Fig. 9). There is abundant fibrinoid also within the penetration zone and in the decidua capsularis. Like fibrin, it has a conspicuous bright red color when stained with eosin.

#### TROPHOBLAST AND PENETRATION ZONE

Trophoblast or trophoderm is the fetal ectoderm by means of which an ovum becomes implanted and through which the implantation cavity is enlarged. It also forms the outer layer of the chorionic vesicle and its villi. In our ovum, it is most abundant at the sides of the implantation cavity (Fig. 2). It lies free for the most part but some masses project from the distal ends of villi. The most striking feature of our ovum is the very widespread invasion of maternal tissue by the trophoblast. This invasion is most evident in the decidua which immediately surrounds the ovum but masses of trophoblast are also found within blood vessels at some distance from the ovum.

There are two distinct types of trophoblast, namely cytotrophoblast also known as cytotblast and plasmoditrophoblast, also known as plasmodium or syncytium. The cells of the cytotblast (Fig. 3) are large, pale, finely granular, polygonal or irregularly elliptical and contain vacuoles. The nuclei which are large and pale are essentially ovoid in shape but many are irregular in outline. Most cells have only one nucleus.

The plasmodium (Figs. 3, 4, 9) stains more deeply and seems to be made up of myriads of small, closely packed granules. There are no cell membranes as in the cytotblast but throughout the plasmodium are scattered large, oval, or irregularly quadrangular nuclei which show bright red nucleoli in the sections stained with Mallory's connective tissue stain.

The cytotblast has long been regarded as an earlier stage in development than the plasmodium but not much evidence has been produced to demonstrate the relationship. Many areas in our ovum show this transition distinctly. The cells of the cytotblast swell, their protoplasm acquires a denser granulation and stains more deeply. The nuclei enlarge and the cell borders disappear (Fig. 3). This change is attributed to contact with the maternal blood.

All the invasion of maternal tissue is by the plasmodium, none by the cytotblast. Most of the invading plasmodium is free from the chorionic plate or villi and most of the invasion takes place in the penetration zone.

In our specimen, the penetration zone is found not only in the decidua basalis but also in the marginalis. It is the dividing line between the fetal and maternal tissue and consists essentially of decidual cells which are in various stages of degeneration and of invading trophoblast. Nearly all the decidua that is adjacent to plasmodial masses is necrotic. A few decidual cells not in contact with plasmodium have pyknotic nuclei and this may be due to the distant action of the plasmodium. In the penetration zone the decidual cells are more *oedematous* and their structure is less distinct than it is elsewhere in the basalis and marginalis. In addition, there are many phagocytic cells. Scattered

throughout the penetration zone are masses of fibrinoid, clumps of maternal red blood cells, leucocytes and pigment granules. There are furthermore in the penetration zone the terminal portions of veins which communicate with the implantation cavity.

When a mass of plasmodium invades the maternal tissue it encounters first a layer of fibrinoid. We find all stages in the invasion of the decidua from a mere contact of plasmodium with the fibrinoid to the stages shown in Figures 4, 5 and 6 in which the fibrinoid has been eroded and ingested and the trophoblast is destroying maternal tissue. In one area where a vein has been invaded one wall of the vein is replaced by plasmodium. In other veins which have been invaded, masses of excellently preserved plasmodium are seen some of them at quite a distance from the implantation cavity (Figs. 5 and 9), hence at this early period we have deportation of fetal elements into the maternal circulation.

In many plasmodial masses and in some of the syncytium which covers the villi opaque and yellow pigment granules are seen (Fig. 4). These probably represent the end products of broken down red blood cells due to the phagocytic action of plasmodium. The pigment is highly insoluble.

The amount of invasion in our specimen is astonishing. At least 12 different sites are found where the plasmodium has broken through the layer of fibrinoid and invaded the decidua or has broken through the walls of veins. In some areas of sections stained with phosphotungstic acid hamatoxylin the union between the decidua and plasmodium is so intimate that only very careful study reveals the boundaries between the fetal and maternal tissues (Fig. 4).

Most of the plasmodium which is free in the implantation cavity and is in contact with blood, has a brush border (Figs. 3 and 6) but the latter is not present everywhere. The plasmodium which invades does not seem to have the brush border except in one place. The brush border may represent a difference between resorbing and invading plasmodium.

In one area of the decidua capsularis a strand of plasmodium coming from the

intervillous space is definitely contiguous with the endothelium of a maternal capillary. Both plasmodium and endothelium stain similarly and only with the oil immersion lens could the contact surface be found between the fetal and maternal elements (Fig. 6).

While in most places the two distinct layers of the trophoblast are seen there are numerous areas where only one layer usually the plasmodial or syncytial is found. This may be because the cytotrophoblast has not proliferated as rapidly as it has been transformed into syncytium and this is especially true where there has been very active growth. We know that by the fifth month there is very little of the cellular layer left on the villi and the explanation is that the growth phase of the trophoblast has disappeared. However even at term one may find an occasional Langhans cell.

#### OPERCULUM DECIDUÆ OR VERSCHLUSS

There is a region where the continuity of the decidua capsularis is interrupted by tissue which differs from the decidua but which resembles plasmodium (Fig. 7). This tissue which was called "Verschluss" by Schlagenhauser and Verocay, and to which Teacher recently gave the name of "Operculum Decidue" extends through the entire thickness of the capsularis. It is situated eccentrically in the capsularis (Fig. 1) and its outer surface is slightly depressed. To its inner surface are attached a small mass of plasmodium with a piece of chorionic membrane torn loose from the ovum. The structure of the operculum is hard to describe. Most of it resembles plasmodium but some areas appear to be granular and ill defined especially at the periphery. In some places there are pale irregularly shaped cells with nuclei which vary considerably in size and shape. The adjoining capsularis stains very deeply and consists almost entirely of a fenestrated fibrinoid which is exactly like the fibrinoid seen in other parts where plasmodium is invading the decidua. In many sections the fibrinoid is found not only on the sides of the operculum but also on its inner surface thereby forming a support on which the

operculum rests. With oil immersion lenses it is definitely seen that the opercular mass is continuous with the chorionic ectoderm and the plasmodial mass attached to its inner surface (Fig. 7). The operculum would, therefore, seem to be fetal in origin and was originally attached to the chorionic vesicle but subsequently tore away. This indicates how firm is the union between ectoderm and operculum. The operculum is an area which represents the last part of the ovum to enter the implantation site and also closes the opening made by the ovum.

#### EMBRYO

The ovum was opened before dehydration had taken place. This was done under fluid with iridectomy scissors, a binocular microscope being used at a magnification of 10 diameters. A nearly spherical vesicle, identified as a yolk sac, was found floating free in the extra embryonic coelom which contained but few delicate strands of magma. The body stalk was also found in situ (Fig. 8). Obviously a break had occurred at the junction of the amniotic vesicle and the body stalk, perhaps during the abortion. The embryo presumably lay spread out on the yolk sac but despite a prolonged study under the most favorable lighting conditions, nothing could be found except an occasional blood island and a nearly circular blister. This proved to be the embryonic disk and its amnion. The yolk sac extends through 43 sections 10 micra thick and has the typical structure of an early yolk sac soon after the appearance of blood islands. The largest section measures 0.64 by 0.53 millimeters. In comparison, the embryonic disk is very small, for it is present in only 15 sections and measures 0.13 millimeters in the fourth section of the series. It is, accordingly, a slightly elongated disk and concave when viewed from above. It would seem probable that the embryo's development was retarded or ceased entirely shortly before the abortion, whereas the membranes continued to develop normally. This is frequently seen in abortive ova. As might be expected from its small size, the embryonic disk shows no sign of a primitive streak or of mesoderm, consisting simply of a pseudostratified columnar epithe-

lium lying upon the yolk sac and passing over more or less abruptly into the amnion. In the region of the embryonic disk the amniotic cavity is exceedingly small. Caudally it would appear that it expands into a rather large vesicle which lies in one side of the body stalk (Fig. 8). This is prolonged as a narrow amniotic duct into the body stalk and ends blindly near its base. The beginning of the allantoic duct can not be made out owing to the distortion in the region where the yolk sac and amniotic vesicles were broken from the body stalk. There is, however, a small spherical vesicle of typical endodermal cells in the body stalk just lateral to the amniotic duct which is undoubtedly the dilated end of the allantois already separated from the rest of the duct.

#### AGE OF THE OVUM IN OUR CASE

It has been the custom of nearly all authors who have reported young human ova to give the age of their ova in days. Most authors have stated the age with great assuredness. Such positive assertions should not be made, however, because we have no accurate criteria for determining the age of early ova. Many important factors concerned in human reproduction are as yet not fully understood. For example, the following essential information is lacking: (1) The exact time of ovulation, (2) the exact time of fertilization, (3) the length of time it takes an ovum to traverse the fallopian tube, (4) the length of time ova and spermatozoa can live and be capable of fertilization, (5) the age at which an ovum is ripe enough to implant itself in the endometrium, and (6) the stage in development of the endometrium at which implantation can occur. Furthermore, (7) the clinical data are not reliable in most cases. Hence, even when the time of occurrence of a single fertile coitus is known, the age of an ovum can not be determined with accuracy.

Many authors have determined the age of their ovum by the size of the blastocyst. Streeter (1920), for example, is of the opinion that "in young stages up to the time of appearance of the primitive groove, the size of the chorion, owing to its rapid growth as compared with that of the embryo, appears to



be a consistent index of the development of the ovum. In older specimens it is necessary to take into account also the morphology of embryo and chorion. Peters (1925), like Grosser (1925) Linzenmeier (1914), and others however insists that this is fallacious because the blastocyst depends for its size upon the extra embryonic mesoderm and later upon the size of the amnion both of which vary considerably. Peters maintains that the age of an ovum depends upon the embryonic anlagen and even this is not absolutely certain. We believe that the most important criterion for seriation should be the stage of development of the embryo and the activities of the chorion should also be taken into account.

Since the data in only very few young ova are strictly reliable there is but little to guide us. The best we can usually do is to locate the position of a new ovum in the series of specimens previously described. Bryce and Teacher (1908) were the first to prepare a table of young human ova. They listed twelve ova and in addition to the clinical information (menstruation, coitus, date of abortion or operation and autopsy), used as criteria of age the total size of the ovum, the size of the blastocyst and where it was known the size and state of development of the embryo. The ages of these ova vary from 13 to 20 days. In tabulating the ova expelled as abortions they deducted two days from the age of the ovum as obtained from the history, one day for the interval which elapsed between coitus and fertilization and one day for the interval elapsing between the death of the ovum and its discharge as an abortion. In the specimens obtained by operation the second deduction was not made. The first deduction coincides with the belief of Mall (1918) that there was a 24 hour difference between what he called 'copulation age' and 'fertilization age'. Grosser (1925) on the other hand does not make the first deduction in his tables because he believes that the time of coitus, ovulation, and fertilization practically coincides in most cases. Teacher in his last contribution (1925) agrees that fertilization normally occurs within an hour or two of insemination

and also that implantation of the ovum more probably takes place on the tenth instead of the seventh day as he formerly believed. The evidence for these conclusions is most in adequate and tables of age must be taken for what they are worth. In addition to the tables of Bryce Teacher (1908) and Grosser (1925) other valuable charts are those of Streeter (1900) von Moellendorff (1921) and Bartelmez and Evans (1926). Where crucial clinical data were stated by authors Streeter in his charts conservatively gives the 'probable age' and the 'possible duration of pregnancy'.

As may readily be seen from the above discussion there is no unanimity of opinion among authors as to the proper way of determining the age of a given ovum and the reasons are obvious. There are too many unknown factors. However, as above mentioned maximum and minimum ages for certain ova have been determined as accurately as is possible and by comparing the development of a new ovum with that of the known listed ova we can with some degree of accuracy, determine the age of the new ovum. However here again we may err somewhat for it does not follow that ova of the same stage of development are necessarily of the same age. We know that there are variations in growth in extra uterine life and late in intra uterine existence. Perhaps there is an appreciable difference in the rate of growth in the very early stages also.

Let us consider our ovum for example. According to the history, the decidua cast containing the ovum was expelled 73 days after the last normal menstrual period. Even if we consider as a menstrual flow, the slight flow of blood which the patient had 29 days after the last regular menses there is still an interval of 44 days between this bleeding and the expulsion of the decidua cast. Nevertheless the development of our ovum clearly belongs in the group listed a 19 day ova by Grosser (1925) and considered to be still younger by Bryce and Teacher Streeter and von Moellendorff. If we rely upon the menstrual history our ovum must have grown very slowly or reached a certain stage of development (19 days) and then

stopped. The excellent state of preservation of the chorion and the embryo would militate against the supposition that the ovum had been dead for a long time before expulsion. Even if we allow the maximum of 3 weeks between menstruation and fertilization there would still be an interval of either 52 days or 23 days between fertilization and expulsion of the ovum. Granting that the latter figure is correct, our ovum must have grown slowly because its development is similar to that of the 19 day ova. Unfortunately we have no coital history but it is of course, possible, that the successful coitus took place 20 days before the expulsion of the decidual cast. This would mean that the fruitful coitus occurred 53 days after the last regular menses or 24 days after the slight bleeding in September. The illuminating gas accident occurred 45 days after the August menses and 16 days after the September show of blood. If the patient were not pregnant in September, why the almost entire absence of the menstrual flow? There are two possibilities. One is that the ovum grew much more slowly than nearly all the reported ova and that its stage of development is that of the ova considered to have a maximum age of 19 days. The other is that for some reason the patient had an amenorrhoea during which she conceived.

Considering the small amount of shrinkage (11 per cent), the measurements as determined from the sectioned material, place the ovum among the youngest of Grosser's 19 day group.

#### SUMMARY

A young human ovum obtained in an aborted decidual cast, is described and the measurements are given. The outstanding feature of this ovum is the unusual amount of invasion of the decidua by plasmodium. There is very abundant trophoblast, especially plasmoditrophoblast, in the intervillous space. There are numerous definitive villi, some of which have begun to branch. Blood vessel anlagen are found in the mesoderm of the chorionic vesicle, the villi, the body stalk and the yolk sac. The few preserved sections of the embryo show a small amniotic vesicle and an embryonic shield lying upon a large yolk sac. In the decidua

capsularis is an operculum decidue (Teacher 1925) which appears to consist of fetal ectoderm and is attached to the chorion leve by a strand of plasmodium. The decidual reaction is more pronounced in the stroma cells than in the glands. Some of the large veins in the spongiosa beneath the ovum communicate with the intervillous space and contain free masses of plasmodium. The development of our ovum tallies with ova considered to have a maximum age of 19 days.

I should like to thank Dr. George W. Bartelmez for his most valuable assistance without which this study would not have been possible.

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CYSTOGRAPHY<sup>1</sup>

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THE roentgenological study of the bladder that has been rendered opaque with a medium impermeable to the roentgen ray antedates pyelography by a number of years. It is interesting to note that while technical difficulties incident to pyelography have largely been surmounted, cystography, a much simpler procedure, has advanced less rapidly. An analogy of the importance and value of the two is inequitable, yet a procedure which involves no greater technical difficulty than that encountered in the aseptic catheterization of the bladder and which is frequently the only source of information concerning disease involving the bladder should be more generally employed. Cystography is not intended to supplant ocular inspection of the bladder but to corroborate the cystoscopic findings and to ascertain data which may not be acquired by means of cystoscopy. Also, when the general condition of the patient or technical difficulties of instrumentation preclude cystoscopy, cystography alone may yield the desired information. It is particularly valuable in ascertaining the extent and treatment of neoplasm in recognizing diverticula, their size and ability to empty, and in demonstrating vesical obstruction, deformity from extravascular pressure, and reflux or regurgitation.

The first attempt to outline the bladder by means of an opaque medium was made by von Zeissel (1902) who experimented on cadavers. Kellar (1904 and 1905) distended the bladder with air and then made roentgenograms in order to portray diverticulum of the bladder. It remained for Voelcker and von Lichtenberg (1906) to demonstrate the possibility of using colloidal silver suspensions as a cystographic as well as a pyelographic medium. Legueu and Papin (1912) published the first complete consideration of cystography and were early advocates of its diagnostic value. They claim priority for its use in the diagnosis of neoplasm. Kelly and Lewis of Balti-

more and Zuckerkandl, of Vienna (1913) working independently, recorded their observations concerning the value of cystograms in the study of vesical neoplasm. In 1912 we commenced to use cystography as a means of determining the nature and extent of diverticulum, and since then its value has been more fully appreciated and its use extended to the diagnosis of other vesical lesions. Legueu and Papin say they were the first to observe regurgitation of the contents of the bladder into the ureter by means of cystography. Thomas (1916) emphasized the importance of lateral cystograms in the diagnosis of diverticulum of the bladder. Kretschmer (1916) presented an excellent detailed description of cystography together with its diagnostic value and limitations. He recognized the importance of examining the patient with the fluoroscope prior to making roentgenogram, and was probably the first to note that regurgitation of fluid into the ureter may occur in children with normal bladders. Bumpus (1924) re-emphasized the value of cystography as an aid in the diagnosis of lesions of the bladder. Coutts has recently revived interest in the value of cystograms made with the patient in the dorsolateral position as practiced by Lerche, Sgalitzer and Hrgntschak and Marion. The method has not as yet been widely used.

The opaque medium employed in making cystograms has not been standardized. Practically all of the various mediums suggested for pyelography have been used. Suspensions of bismuth subnitrate and barium sulphate have been utilized by European workers, notably Papin, Gangelen and Uray. Pfister suggested the possible danger of stone formation from the retention of particles of these salts in the bladder, although such an occurrence has not been reported. More recently the preparations of iodized oil, particularly the 40 per cent preparation as advocated by Sicard and Forestier, have gained popularity.

Many urologists continue to use solutions of the halogens but the intense burning that often follows precludes their use in the inflamed bladder. A 5 per cent emulsion of silver iodide was suggested by Kelly (1913). This is the medium of choice at the Mayo Clinic, as it not only serves as an excellent contrast medium but as a soothing and antiseptic agent.

"Pneumocystoradiography," or distention of the bladder by means of air or gas, is used considerably abroad, although not generally in this country. It is objectionable because of the accompanying pain from overdistention, the danger of emphysema of the surrounding tissues, and the uncertainty of the outline, which must often be distinguished from that caused by gas in the bowel. The use of oxygen perhaps minimizes these objections. Nevertheless, the cystograms resulting are not usually as satisfactory as those obtained by an opaque medium. Rosenstein proposes to distend the space of Retzius with air or gas as well as the bladder in order to demonstrate more clearly the kind and extent of the vesical lesion, thus making the wall of the bladder visible. The bladder can be filled with opaque medium in place of air or gas. Pfahler (1919 and 1924) reviewed favorably his experience with pneumocystoradiography in the diagnosis of neoplasm of the bladder.

The technique of making serial cystograms by distending the bladder with opaque medium and making roentgenograms at different angles has for years been the method of choice. It has been used at the Mayo Clinic for the last 10 years. Hinman (1919) and Herbst (1924) describe a method in which the bladder, after being emptied of urine, is distended with opaque medium (15 per cent sodium iodide) and a roentgenogram made. The bladder is then emptied of contrast medium by means of a catheter and air immediately injected. A second roentgenogram is then made. This shows retention diverticula sharply outlined by the retained contrast fluid, the bladder being dark from the presence of injected air. Kretschmer used a modified method in which the ureteral catheter is coiled in the diverticulum and the medium injected. Gas or air is injected into the bladder for con-

trast medium. In 1924 La Rose proposed a method of portraying diverticulum by using an opaque medium of different density. The bladder is first emptied and then filled with a 15 per cent solution of sodium iodide, the patient is turned from side to side in order to fill the diverticulum, the excess medium in the bladder is withdrawn, and the bladder again distended with 0.5 per cent solution of sodium iodide. Stereoscopic films are then made.

While various radiographic techniques have been suggested, the following has given satisfactory results: simple roentgenograms of the bladder area are made prior to cystography in all cases. Three film exposures give a series of cystograms which aid in the identification of lesions of the bladder. The first two films are made with the bladder fully distended with 5 per cent emulsion of silver iodide and the urethral catheter withdrawn. The patient is placed in the reverse Trendelenburg position, with the table at an angle of 10 degrees toward the foot. The Coolidge tube is placed at an angle of 5 degrees, which makes a total of 15 degrees inclination toward the foot. The tube is also tilted at an angle of 8 degrees to each side in order to secure lateral exposures, similar to making stereoscopic views. The two lateral views at opposite angles appear to portray more clearly the position of diverticula and defects than does a single film in the vertical plane. When the bladder is emptied preparatory to taking the third film no pressure is exerted. It is safer to rely on catheterization to remove the contents of the bladder than on the patient's efforts. In cases of extensive intravesical hypertrophy of the prostate it may be impossible to empty the bladder completely, a certain amount remaining in the base as a crescent in the third film. No effort to empty the bladder by pressure with the cone or the hand over the symphysis pubis should be made as this may lead to distortion of an otherwise normal cystogram or to the emptying of a diverticulum. The third film is made with the bladder empty, the table being tilted 10 degrees with a 5 degree angulation of the Coolidge tube, making this also an angle of 15 degrees. This film is made in the anteroposterior position without any lateral angulation of the tube. When the legs are supported

in the stirrups of the cystoscopic table (with the patient in the usual position for cystoscopy) the combined angulation of 15 degrees causes the pubic bones to be thrown forward permitting a much more complete view of the bladder outline. At no time is compression made with the cone. The first two films are exposed  $4\frac{1}{2}$  seconds the third film 4 seconds and the film voltage is stepped down 2 kilovolts a 30 milliamperé Coolidge tube is used. The spark gap however may be adjusted according to the size of the patient.

As artifacts may easily occur as a result of incomplete distention of the bladder with opaque medium and through faulty preparation of the patient these factors deserve special attention in the elimination of error in interpretation. It is extremely important that patients take repeated enemas prior to reporting for cystograms. In order to distend the bladder completely the cystographic medium is injected until the patient begins to feel uncomfortable and expresses a desire to urinate.

#### NORMAL CYSTOGRAMS

Normal cystograms are not constant in shape and size. They may be circular or oblong, pyramidal or pear shaped and vary from 8 centimeters in length to a size which completely fills the pelvic basin. The base usually appears just above the symphysis pubis the greatest dimension being either in the transverse or vertical plane. The differences in the outlines of the female and male bladders were early recognized by Legueu and his associates. The characteristic of all types is the regular outline. In infants the bladder is correspondingly larger and appears higher in the pelvis.

#### DIVERTICULUM

Probably in no other lesion of the bladder is cystography so important as in diverticula. They may easily be overlooked in examining infected or deformed bladders although they are generally diagnosed by cystoscopic examination. Furthermore their exact size and relation to the bladder and ureter can also be ascertained by this means. As the size of the orifice of the diverticulum is no indication of its capacity or of its ability to empty, cystog-

raphy affords a means of determining the size of the diverticulum as well as to what extent the diverticulum drains when the bladder is emptied. The nature and size of the diverticulum obviously indicates the type of treatment required. Not only is diverticulum predisposed to chronic infection because of stagnation of urine but other diseases incident to obstruction may be coexistent. Stones are found rather frequently in diverticula. When present they are usually single and may be large. They are frequently dumb bell in shape with one end in the diverticulum and the other in the bladder. Their occurrence should be considered when the original roentgenogram shows a shadow in the bladder area suggestive of stone which cannot be identified by cystoscopic examination. Neoplasms in diverticula are comparatively rare. They may exist in a diverticulum independent of the rest of the bladder and in such cases can be recognized in the cystogram by an irregular filling defect in the outline of the diverticulum.

Cystoscopy often reveals orifices in the wall of the bladder the exact nature of which cannot be determined by inspection alone. Prolonged obstruction in the neck of the bladder as well as atony secondary to cord lesion results in a honey comb appearance called trabeculation. An exaggerated degree of trabeculation may give rise to cellulæ. Both of these conditions can be demonstrated in the outline of the cystogram. As the size of the orifice is no indication as to whether they are cellulæ or true diverticula their exact nature can often be identified only by cystography. The differentiation of small diverticula is not always an easy matter. As a general rule they are not of surgical importance and for convenience may be regarded as large cellulæ rather than true diverticula.

#### OBSTRUCTION OF THE NECK OF THE BLADDER

Cystoscopic inspection of the bladder of patients suffering from prostatic hypertrophy is often desirable though not always advisable or feasible. Cystograms in such cases may reveal conditions that modify the surgical procedure. Because of the frequent occurrence of diverticulum of the bladder with



Fig 1



Fig 2



Fig 3



Fig 4



Fig 5



Fig 6



Fig 7



Fig 8



Fig 9

Figs 1 and 2 Normal cystograms made at lateral angles as indicated in the technique described

Fig 3 Circular type of normal cystogram (lateral ray)

Fig 4 Large type of normal cystogram in the female the pelvic basin appears to be filled

Fig 5 Small pyramidal type of bladder (female) Cystogram with patient in extreme Trendelenburg position

Fig 6 Diverticulum in a bladder with lead catheter coiled within

Fig 7 Diverticulum distended with medium demonstrating capacity of diverticulum (same as Figure 6) Note that none of the medium has passed from diverticulum into

bladder The method of coiling a lead catheter in a diverticulum may be of considerable aid in demonstrating diverticula in the dome which may be difficult to outline in the cystogram if diverticulum completely empties

Fig 8 Lead catheter in diverticulum Some of the medium injected into the diverticulum has escaped into the bladder The true capacity of diverticulum, therefore not accurately determined

Fig 9 Same case as Figure 8 Cystogram illustrating large capacity of diverticulum and the value of this method over that of coiling a lead catheter in the diverticulum and attempting to distend it with opaque medium



Fig 10



Fig 11



Fig 12



Fig 13



Fig 14



Fig 15

Fig 10 Irregular outline of bladder with smooth outline of diverticulum in left base

Fig 11 Same case as in Figure 10 Third plate after emptying bladder Note the smooth outline of large diverticulum which does not empty There is some residual medium in bladder which was not completely emptied by catheterization Note that in Figure 12 the outline of the bladder partially obscures the outline of the diverticulum

Fig 12 Unusual outline of bladder with multiple diverticula whose combined capacity is larger than that of the bladder

Fig 13 Second view with bladder empty showing three huge diverticula in left and right bases which do not empty (same case as in Figure 12)

Fig 14 Large sacculations (sometimes termed false diverticulum) in dome suggestive of diverticulum and definite elevation of base secondary to prostatic hypertrophy (malignant) No diverticulum demonstrated on exploration

Fig 15 A very distinct elevation of the base of the bladder as the result of extensive intravesical prostatic hypertrophy

prostatic hypertrophy and the difficulty of recognition by cystoscopy we have adopted a plan whereby cystograms are made in all cases of prostatic hypertrophy before operation is considered A study of a great many of these cystograms has led to some interesting observations As a result of hypertrophy of the prostate a filling defect is often visible in the base of the cystogram As this deformity however is not constant different types of obstruction are probably responsible for the variation It has been noted that hypertrophy of the prostate which is confined chiefly to the

urethra may not appear in the cystogram as a deformity of the neck of the bladder Intravesical prostatic hypertrophy in which the internal sphincter is elevated but otherwise intact may give rise to considerable deformity of the base of the bladder characterized by flattening or distinct elevation Occasionally in an extensive intravesical prostatic enlargement when the internal sphincter is not preserved regurgitation of the medium into the urethra may occur The resulting cystogram usually shows a distinct elevation of the trigone and a variable outline of the



Fig 16



Fig 17



Fig 18



Fig 19



Fig 20



Fig 21

Fig 16 Irregular cone shaped bladder with slight elevation of base occurring with prostatic hypertrophy

Fig 17 Unusual type of bladder deformity occurring with prostatic hypertrophy giving rise to cocked hat appearance. This type of bladder may be frequently demonstrated in prostatic cases after drainage by an indwelling urethral catheter. Indentations in base probably correspond to extension of lateral lobes into bladder.

Fig 18 Elevation of base of bladder with regurgitation of medium into posterior urethra as a result of considerable intravesical enlargement of the prostate in which the internal sphincter has not remained intact.

Fig 19 Large indistinct filling defect in bladder base due to a huge prostate.

Fig 20 Third view after the bladder has been emptied by catheter. The high lying crescent shadow appearing in right base as a result of residual medium which could not be completely removed by catheter because of the large size of the prostate the intravesical portion of which it apparently outlines (same case as in Figure 19).

Fig 21 Small irregular bladder with multiple cellules and reflux of medium up the right ureter secondary to prostatic hypertrophy. Small diverticulum in dome indistinctly outlined.

adjacent portion of the urethra. It should be noted that apparent deformity in the base of the bladder in the cystogram is but presumptive evidence of prostatic hypertrophy. Additional data are required for a positive diagnosis.

The size of the prostate is not commensurate with the degree of elevation. It has been noted that extensive prostatic hypertrophy may cause but little elevation in the base of the cystogram, and vice versa. Elevation of the base of the bladder is occasionally noted

with spasm without prostatic hypertrophy. Aside from the crescent deformity in the base various irregularities may be noted, any one or all of which may be concomitant with the elevation of the base. They are (1) irregularity of the outline of the bladder as a result of trabeculation and cellules, (2) diverticula, (3) regurgitation of medium into one or both ureters, and (4) localized sacculations.

Sacculations of the wall of the bladder may produce a distorted outline in the cystogram suggestive of diverticulum. Sacculations prob-





Fig 22



Fig 23



Fig 24



Fig 25



Fig 26



Fig 29

Fig 22 Irregular filling defect in left base wall and dome was a result of neoplasm. Operation revealed inoperable carcinoma involving approximately half of the bladder.

Fig 23 Extensive carcinoma of the bladder with irregular filling defect in left wall and dome. Exploration showed about one third of bladder to be involved.

Fig 24 Extensive filling defect of base and dome as the result of extensive carcinoma (inoperable).

Fig 25 Irregular filling defect of base as a result of

extensive carcinoma of the internal sphincter and bladder base.

Fig 26 Unusual position of bladder with marked deformity as a result of displacement and pressure from a large cyst originating either from the prostate or seminal vesicles.

Fig 29 Irregular cone shaped bladder with regurgitation of medium into posterior urethra as a result of relaxation of internal sphincter secondary to cord lesion.

ably result from areas of bulging in the wall of atonic bladders and should be borne in mind in the differential diagnosis of true diverticula. It has been noted that when deformity of the bladder occurs as the result of an apparent pouching of its wall the outline of the cystogram is regular. This is in contrast to the irregular outline of the bladder so common with diverticula. Sacculations or false diverticula always completely empty themselves.

Carcinoma of the prostate does not cause any typical deformity in the bladder outline. As a rule the elevation of the base of the bladder is more diffuse, flatter and not so marked

as with adenoma. Filling defects in the base or wall of the bladder as a result of secondary involvement may occasionally occur.

#### DEFORMITY FROM NEOPLASM

It may be impossible to make a satisfactory cystoscopic examination in the presence of a tumor in the bladder because of profuse hæmorrhage, intolerance, vesical contraction or deformity. In such cases a cystogram may reveal the extent and situation of the neoplasm and aid in determining the proper treatment generally. Generally when the filling defect is extensive and involves most of the bladder outline, it may be regarded as in-

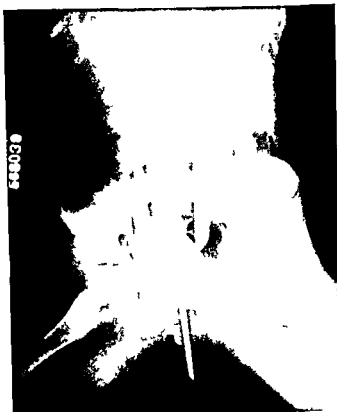


Fig 27 Value of cystography in a case of persistent pyuria in a female child of 8 years. Note small irregular bladder with regurgitation of medium up both ureters and pelvis. Bilateral hydronephrosis and hydro ureter as the result of congenital atony of the urinary tract



Fig 28 Bilateral hydro ureter and hydronephrosis in case of man aged 21 with marked urinary infection

operable, although a large pedunculated tumor, particularly of the benign type, may cause an immense filling defect, giving a false impression of an inoperable tumor. The outline of a bladder containing a neoplasm is characterized by an irregular filling defect at the site of the tumor. The extent and situation of the filling defect will vary with the thickness and size of the tumor. Occasionally the tumor is more extensive than the deformity would indicate. It should be noted that in some cases of hemorrhage blood clots in the bladder may produce filling defects in the cystogram which may simulate the deformity caused by tumor. The site and extent of tumors involving the sphincter may be difficult to determine by means of cystoscopy. These can often be more accurately ascertained by cystography.

#### INFLAMMATION

Prolonged inflammation of the bladder, such as occurs secondary to pyelonephritis or renal tuberculosis, may cause marked de-

formity of the bladder outline. The cystogram appears small, contracted and irregular, and often cone shaped. A similar deformity may be seen in a cystogram made of a bladder which is being continuously drained by an indwelling catheter. As a result of coincident inflammatory changes in the lower part of the ureter, regurgitation of the medium up one or both ureters may be demonstrated.

#### EXTRAVESICAL PRESSURE

Pressure on the bladder from adjacent structures may be demonstrated in the cystogram. Cystography may also occasionally be of some aid in the recognition of extravesical lesions. Elevation of the base of the bladder by hypertrophy of the prostate has been described. Tumors of the cervix may cause a similar deformity. With tumor of the body of the uterus, there may be a distinct cleft in the outline of the dome of the bladder as the result of pressure. The deformity may cause a filling defect similar to that produced by neoplasm. As a rule, however, the latter is differentiated by greater irregularity of the filling defect. Cysts



Fig. 30. Cystogram of cord bladder occurring in a young boy following an attempt to repair a spina bifida. Note irregular outline of bladder resulting from cellulæ and trabeculation and reflux of medium up both ureters demonstrating bilateral hydro-ureter and hydronephrosis. The internal sphincter is relaxed. Some medium may be seen in the bulbous portion of the posterior urethra.

arising from the prostate or seminal vesicle may cause rather marked displacement and deformity of the bladder outline. Similar displacement may result from perivesical abscess. The deformity simulates that of bladder neoplasm but is not as a rule as irregular as that occurring with vesical neoplasm. In huge inguinal hernias if the scrotal contents are uncertain a cystogram may be of value in excluding or demonstrating hernia of the bladder.

#### REGURGITATION OR REFLUX

The passage of fluid from the bladder into the ureters can be demonstrated by means of cystography. Graves and Davidoff in numerous experiments sought to explain the phenomenon of the regurgitation of vesical contents. It is probable that in normal persons the mechanism of the ureterovesical juncture is so regulated that the bladder contents do not flow back into the ureter. Under patho-

logical changes both local and general this mechanism is altered and permits communication between the bladder and renal pelvis. This is illustrated in case of patulous ureters resulting from chronic pyogenic and tuberculous infections of the urinary tract. In lesions of the spinal cord as a result of disease or injury a similar occurrence takes place because of atony. Bladder contents occasionally gain entrance to the ureter as a result of obstruction in the region of the vesical neck. Graves and O'Connor distinguish between the terms regurgitation and reflux. Regurgitation denotes the passage of bladder contents into the ureter or kidney when the bladder and ureteral muscle tone is obviously normal. In the passage of medium into the ureter by direct continuity due to loss of bladder and ureteral muscle tone as a result of the obstruction of the neck of the bladder and from disease of the spinal cord they give the term reflux. At present the terms reflux and regurgitation are used rather interchangeably, either term indicating a continuous communication between bladder and ureter regardless of the etiological factor. Because of the frequent occurrence of ureterectasis with infection and pyelitis with regurgitation of vesical contents in infants, a cystogram is of considerable importance in determining the actual condition of the urinary tract. It is indicated in all cases of persistent pyuria in infants not controlled by medical measures.

#### CORD BLADDER

Disease or injury of the spinal cord frequently results in lesions of the bladder requiring the aid of the urologist. Occasionally the lesion may be the first manifestation of the disease and cystoscopy may give the first clue to the disorder. Cystography is often of aid in establishing the diagnosis. The changes in the cystogram incident to the disease are consistent and are characterized by the outline of a large irregular bladder, relaxation of the internal sphincter as indicated by regurgitation of medium into the posterior urethra and frequently by regurgitation of medium up one or both ureters. On account of relaxation of the internal sphincter and regurgitation into the posterior urethra there is frequently a

triangular shaped extension from the median base of the bladder outline into the urethra for a distance of 1 to 2 centimeters with its apex in the urethra (Figs 1 to 30)

## SUMMARY

Cystography is not intended to replace ocular inspection of the bladder but to corroborate cystoscopic findings. It may be of considerable value in ascertaining the presence of bladder lesions when the general condition of the patient or technical difficulties preclude cystoscopy. Cystography affords a means whereby diverticulum of the bladder is recognized and also furnishes information as to the capacity and ability of the bladder to empty.

In cases of vesical neoplasm cystography may portray the site and extent of the malignancy and determine the advisability of operative procedure.

Lesions of the bladder secondary to cord changes may be recognized by characteristic variations in outline together with evidence of regurgitation of medium into the ureter and urethra. Various deformities of the bladder occurring with hypertrophy of the prostate have been noted.

The importance of cystography in infants with persistent pyuria is emphasized because of its value in determining the presence of atony of the urinary tract with resultant ureterectasis and pyelectasis. Deformity of the bladder from extravascular pressure may be recognized in the cystogram, the outline of which is usually regular in contrast to the more irregular filling defect caused by neoplasm.

A satisfactory technique for making cystograms is described.

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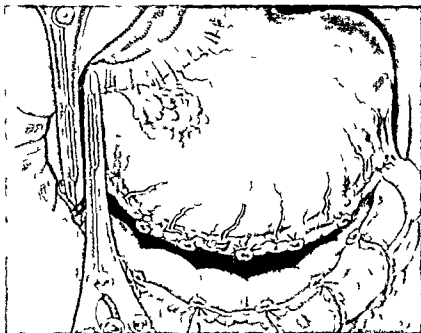


Fig 3 Division of the duodenum

*Partial Gastrectomy for Gastric Ulcer —Digby Chamberlain*

# CLINICAL SURGERY

FROM THE CLINIC OF SIR BERKELEY MOYNIHAN

## PARTIAL GASTRECTOMY FOR GASTRIC ULCER

By DIGBY CHAMBERLAIN (H.M. F.R.C.S. LEEDS ENGLAND)

The General Infirmary at Leeds

WHEN the question of the desirability of performing a partial resection of the stomach for ulcer is being considered, if we regard it from the purely statistical point of view completely ignoring the greater comfort and the more certain relief of symptoms which follow this operation, we find that it is unquestionably the treatment of election. The dangers of perforation of the ulcer or hæmorrhage from one of its supplying vessels may be disregarded, as they can be minimized, if not completely overcome, by almost all the other operations which have been described. The complication of malignant disease, which can be dealt with effectively only by this operation provides figures which are a certain guide. The incidence of carcinoma in neglected ulcers of the stomach has been variously estimated, but if we accept the conservative figure of 9.5 per cent, which is the outcome of a detailed examination of 216 consecutive cases at Leeds, we see that one person out of every ten who has a gastric ulcer is doomed to die from carcinoma of the stomach. The mortality for partial gastrectomy as I am about to describe it has been about 3 per cent during the last 10 years, so that the non-operative mortality is three times as great as the operative. An operative mortality of this size can be attained only by the utmost attention to detail during the operation and careful pre-operative and post-operative treatment.

### COMPLICATIONS

Reports have been made from time to time of leakage from the suture line, in most cases from the cut end of the duodenum with the production of a general peritonitis. In one case, where a cholecystectomy had been performed at the same time, I have seen an obstruction to the transverse colon by the pre-anastomotic part of the jejunum, the postanastomotic part having

become adherent to the gall bladder fossa. Anastomotic ulcers have been reported in rare cases, but if the operation is regarded merely as an incident in the treatment of gastric ulcer and not as a panacea for the future, this complication is not likely to be encountered. It may be that postoperative bleeding from the suture line is a potent causative factor, as the raw area, which must be left exposed to the action of the gastric secretions, may be the starting point of an ulcer which may not call attention to itself for weeks or months. Actually, we have never had a case of anastomotic ulcer following partial gastrectomy for gastric ulcer, the only cases which have occurred here have been after resection of the stomach for ulceration at the site of a previous gastro-enterostomy opening.

### PRE-OPERATIVE TREATMENT

It has been the custom to keep the patient in hospital for a week or 10 days before operation, so that he may become accustomed to his new surroundings and have a complete radiological and chemical investigation done. During this time any focus of infection which may be present is dealt with, particular attention being directed to the mouth where carious teeth are extracted and any septic cavities are rendered aseptic and filled.

As many of these patients are anæmic and somewhat emaciated, blood transfusion on one or more occasions, according to the general condition, is employed. A 5 per cent solution of glucose is given by the rectum or by the mouth if it can be tolerated, until 15 or 20 pints have been absorbed. Sugar may appear in the urine, so that the presence of diabetes is to be eliminated before the administration of glucose is begun. In some cases the patient is sent to a convalescent home or to the seaside for 2 or 3 weeks before the operation is undertaken. Artificial sunlight

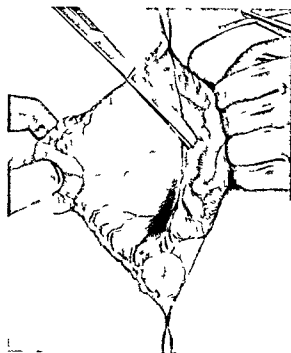


Fig 1 Flat swabs being put into position to hold the stomach over to the right

baths have also been used pre operatively in many cases

While in hospital he is kept on a light but nutritious diet until the evening before operation when a purge of castor oil is given to be followed by an enema on the following morning. Stomach washes are not used except in the occasional case in which there is complete retention and putrefaction is going on as they usually upset the patient considerably. The skin is prepared for operation over an area extending from the nipples to the thighs a 3 per cent solution of picric acid in spirit being used as a final application after which a sterile sheet is fastened round the patient. Finally before leaving the ward for the operating theater the patient is given an injection of morphia  $\frac{1}{6}$  grain and scopolamine  $\frac{1}{200}$  grain

#### THE ANÆSTHETIC

Anæsthesia is produced by gas and oxygen administered through a Boyle's apparatus. A little ether is added while the abdomen is being opened and closed but the amount used rarely exceeds 1 to 2 ounces. In cases in which there is some degree of bronchitis atropine  $\frac{1}{100}$  grain has been found to be advantageous and may be substituted for scopolamine in the preliminary injection

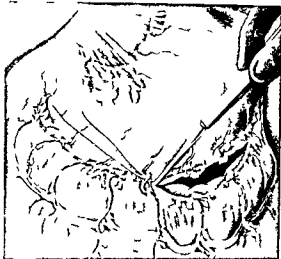


Fig 2 Greater omentum being detached from the greater curvature of the stomach

#### THE OPERATION

The abdominal wall is prepared as in the pre operative preparation except that the final application is Harrington's solution in this case. The sheets are then adjusted. It has been found less trying to the eyes of the operator if the sheets are green. A red square is put on the instrument tray at the foot of the patient on which soiled instruments may be placed. Once an instrument is on the red square it is not touched except to be taken away and resterilized.

The abdomen is opened by a paramedian incision extending from the costal margin to just below the umbilicus the rectus muscle being displaced outward. Every bleeding point is clipped with artery forceps and ligatured with fine catgut before the peritoneum is incised. Some of the muscular branches may retract into the rectus and can be controlled only by a stitch. As soon as the rectus sheath is reached tetra cloths are applied to the edges of the wound gripping the tetra the sheet, and between them the skin so that the skin is not punctured. The tetra is folded back over the forceps which are thus hidden and prevented from getting entangled with ligatures during the subsequent course of the operation. The peritoneum is then picked up and opened.

We examine the stomach visually and by palpation starting at the oesophageal opening and working along the lesser curvature. The rest of the abdominal viscera are palpated to exclude coexisting disease and the cæcum is delivered out

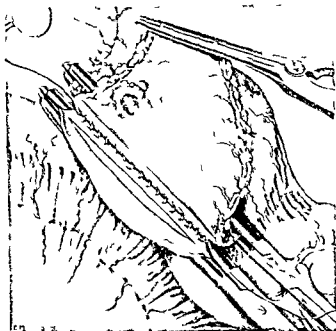


Fig 4 Serosal stitch inserted Stomach ready for removal

of the lower end of the wound and the appendix is crushed and removed.

To make the stomach more accessible and to prevent it from retracting after it has been divided, a large flat swab is packed into the abdomen in the following way. The stomach is drawn out of the wound to the right as far as possible, the left side of the abdominal incision is held up by an assistant, and the flat swab is packed down between the two so as to hold the stomach over to the right (Fig. 1).

A piece of the lesser omentum above the first part of the duodenum is selected and divided between ligatures. A finger is passed through this opening, behind the duodenum to the great omentum, where an avascular space is opened out and a clip passed through it on to the tip of the finger. The clip is passed deep to the duodenum and through the opening in the lesser omentum, keeping in contact with the finger the whole time. One blade of a Payr clamp is seized by the clip which is then drawn through behind the duodenum, when the clamp can be tightened. A second Payr clamp is passed close to the first one and the duodenum divided between the two. The cut ends are sterilized by applying to them pure carbolic acid or heat from the actual cautery.

As a modification of this the following plan has been adopted recently. A start is made by picking up a piece of the great omentum about the middle of the greater curvature and dividing it between ligatures (Fig. 2). This division is



Fig 5 Operation complete. Note the close relation of the jejunum to the splenic flexure of the colon.

carried along to the right to the duodenum and then a piece of the lesser omentum at the upper border of the duodenum is similarly divided between ligatures. Clamps can be applied and the duodenum divided as already described (Fig. 3). By approaching the duodenum in this way, we obtain much freer access, and the blade of the clamp which lies deep to the duodenum, can be passed under direct vision.

The great omentum is next detached from the greater curvature of the stomach. It is punctured by an aneurism needle guided by the finger, a double ligature is drawn through, tied, and the omentum is divided between the ligatures. This division is carried up beyond the ulcer and the lesser curvature is similarly dealt with, great care being taken to ligate the coronary artery securely. When this vessel, which acts as an anchor, is divided, the stomach can be delivered more completely from its bed.

At this stage, the cut end of the duodenum is closed. A continuous thread suture is put into the duodenum over the Payr clamp, which is then withdrawn and the crushed end invaginated. The stitch is carried back to the starting point and tied. It is usually possible to bury this closed end in the peritoneum covering the anterior surface of the pancreas.

A clamp is now applied to the stomach above the ulcer, and the first loop of the jejunum is identified. This is brought straight from the duodenojejunal flexure across the transverse colon close to the splenic flexure and directed across the abdomen from left to right parallel to the stomach clamp and a clamp is applied to it.



The distance from the duodenojejunal flexure to the proximal part of the anastomosis is about 4 inches. Everything except the stomach and this small piece of the jejunum should be inside the abdomen and protected by mackintosh cloths. It is a rule to which there is no exception that only that part of the gastro intestinal tract which is being operated on should be visible and by adhering to this rule loss of heat and moisture from the viscera and therefore shock are reduced to a minimum.

All suturing is done with chromicized catgut its size being 000000. It is used in an intestinal needle curved to an arc of  $\frac{5}{8}$  of a circle and having a spring eye. Starting at the greater curvature we insert a continuous stitch to join the peritoneum on the opposite sides of the stomach and jejunum (Fig. 4).

The stomach is held up by the assistant and a cut is made through the serous and muscular coats on both sides  $\frac{1}{2}$  inch or  $\frac{3}{4}$  inch from the clamp. This incision must be well away from the clamp particularly on the anterior surface of the stomach as the cut end of the stomach tends to retract into the clamp. A second clamp is applied to the stomach close to and distal to the first one and before being completely closed is worked along to lie just distal to the sero-muscular incision, in such a way that it empties the lumen between the clamps of its contents. The mucous membrane is next divided with scissors along the line of the sero-muscular cut any contents of the stomach which are present being mopped up and the stomach is removed.

An incision is made into the peritoneum of the jejunum equal in length to the cut end of the stomach and the mucous membrane oval in shape which bulges through this cut is removed with the scissors. Again starting at the greater curvature we insert a continuous catgut suture taking up the mucous membrane and muscle, right round the circumference of the stomach. This suture is simply a running stitch except at the ends where one or two Connell stitches are employed to turn the corner. It is better that the mucous membrane should show between the stitches as hæmorrhage is thereby insured. This stitch is then tied off at its starting point. In order to facilitate the insertion of this stitch the following plan has been adopted. The assistant holds a closed pair of artery forceps in his right hand and a thread holder in his left hand with this latter he grasps the stitch as soon as it has been drawn tight while the forceps are held on the suture line immediately behind the stitch which is being inserted in order to guide it

accurately into position. In this way the stitch as it is being drawn tight is prevented from picking up a piece of mucous membrane at a distance. This plan is used only while the posterior layer of stitches is being inserted. When the anterior surface of the stomach is being stitched to the jejunum it is essential that the needle should not pick up the posterior suture line and to prevent this the flat blade of a pair of scissors is laid on this suture line and held by the assistant in such a way as to protect it. Four or five retracting stitches are put into the suture line before the clamps are removed as otherwise the stomach tends to retract to a place where it is not accessible. The clamps are then removed all swabs which have been used thrown away and gloves which may have become infected from the mucous membrane changed.

The peritoneal stitch is picked up and run from the lesser to the greater curvature of the stomach where it is tied off to its commencement. It will be found that large vessels at the two curvatures course toward the suture line and it is better to make certain that they are occluded by under-running them with a stitch. The suture line is inspected and if necessary reinforced at one or two places by an additional stitch. The retracting stitches are cut out and the flat swab which was put up against the spleen at the beginning of the operation is taken out when it will be found that the stomach retracts almost out of sight under the ribs (Fig. 5). Finally before the abdomen is closed the great omentum is folded up in such a way that it covers the suture line and prevents it from adhering to the anterior abdominal wall.

In some cases the operation is complicated by the fact that the ulcer is adherent to surrounding structures, frequently the pancreas when it must be separated from that organ with a scalpel. No danger is to be feared from leaving this raw area of pancreas as it is fibrosed and pancreatic juice will not escape from it but to prevent adhesions it is better if possible to cover it over with a neighbouring piece of peritoneum or fat. Before the abdomen is closed, about half a pint of normal saline solution may be left in the peritoneal cavity from which the solution will be rapidly absorbed.

The abdomen is closed in layers a continuous catgut stitch being used for the peritoneum interrupted catgut stitches for the anterior sheath of the rectus and silk worm gut sutures through the skin, superficial fat and the anterior sheath of the rectus. When the tetra cloths are removed that is when the peritoneum has been closed

the skin should be recleaned with pink spirit. Finally, the skin edges are approximated by means of Michel clips and a sterile dressing is applied.

In order to save time, two theaters are used, an assistant opening and closing the abdomen in one, while the surgeon carries out the intra-abdominal part of the operation in the other. The surgeon does not leave a case until the peritoneum is closed, so that there can be no chance of a swab being left behind.

The patient is wheeled back to the ward, and as soon as the effects of the anæsthetic have passed off, he is put up into Fowler's position. Glucose is administered by continuous rectal infusion and in bad cases a further transfusion of blood is given.

Feeding is commenced on the following day by giving small frequent sterile drinks, which are gradually increased in amount. Milk pudding is given on the seventh day and chicken on the tenth. The patients are allowed to get up after 3 weeks, but should be warned that for a time at least, it is essential that they should exercise a certain amount of care in their diet. On leaving the hospital they are given a chart suggesting on broad lines, what should be taken. In addition, smoking is forbidden and alkalis are taken before meals for 6 months.

As to the efficacy of the operation, I cannot do better than to quote a patient whom I saw recently, 2 years after his stomach had been removed, and who, on being questioned, said that he felt as if he could digest a brick.

## FROM THE SURGICAL CLINIC OF GUI'S HOSPITAL

## CHOLECYSTECTOMY

By R. P. ROWLANDS OBE MS (LOND) FRCS (FAC) LONDON ENGLAND

Jegen to Guy Hosp (1)

## INDICATIONS FOR OPERATION

THE chief indications for cholecystectomy are irreparable wounds and injuries or diseases of the gall bladder and its ducts in cases in which the common bile duct is healthy and patent. The following are the most important of these diseases: Acute chronic and recurrent cholecystitis especially when associated with gall stones gangrene perforation with or without cholelithiasis empyema hydrops or mucous fistula of the gall bladder due to obstruction of the cystic duct by stone kink or stricture papilloma or carcinoma of the gall bladder volvulus of the gall bladder and biliary fistula or chronic jaundice due to kinking of the common bile duct following cholecystectomy.

It is not wise especially for a surgeon without special experience to undertake this operation when the patient is very ill old or feeble or when the mechanical difficulties of the operation are great. Cholecystostomy is safer under such circumstances. Secondary cholecystectomy can be performed under more favorable circumstances if the symptoms recur. Neither should cholecystectomy be attempted when there is jaundice of some weeks duration with consequent risk of hemorrhage unless the normal coagulation time has been restored by treatment nor when there is cholangitis. Cholecystectomy should never be performed unless it is certain that the common bile duct is patent.

## DANGERS AND POSSIBLE COMPLICATIONS

An accurate knowledge of the normal and abnormal anatomy of the biliary apparatus is essential to all surgeons who undertake operations on these intricate parts (Fig. 1). E. R. Flint (1) has drawn attention to abnormalities of the bile ducts and associated blood vessels and has rightly laid stress upon their surgical significance. The arrangements of the vessels and ducts given as normal in the textbooks was found in only 69 out of 200 consecutive dissections. Lack of knowledge of abnormalities and want of care in exposing the ducts may lead to severe hemorrhage or to grave injuries of the ducts during the operation of cholecystectomy. The occasional presence of the

right hepatic or cystic artery in front instead of behind or to the left of the common hepatic or common bile duct may lead to trouble. An accessory right hepatic duct which is present in about one seventh of the cases, is very liable to be divided and if this accident is not recognized the escape of bile into the peritoneum may lead to death especially if the abdomen has been closed without drainage.

Abnormalities of the cystic duct have often led to error. This duct may be absent (Walton 3) unduly short or abnormally inserted into the common bile duct behind or on the left side of the latter. It commonly runs parallel to the common bile duct and is adherent to it for some distance before actually opening into it. In about one seventh of Flint's dissections the cystic duct opened into the retroduodenal part of the bile duct so that there was no common bile duct above the duodenum.

The pelvis of the gall bladder often enlarges and extends in front or behind the common bile duct to which it may be intimately adherent so that the latter may be mistaken for the cystic duct and divided.

## PREPARATION OF THE PATIENT

Except in urgent cases the patient is kept at rest and prepared for 2 days before the operation. An aperient is given not later than 24 hours followed if necessary by an enema not later than 8 hours before the operation. The mouth is carefully cleansed and if necessary the operation is deferred until all signs of oral sepsis have been eliminated. It is particularly important to do so if there is any indication of recent acute septic infection of the nose or throat on account of the danger of pneumonia supervening. If the clotting time of the blood is above normal because of obstructive jaundice I inject intravenously 5 cubic centimeters of a 10 per cent sterile solution of calcium chloride (2) once a day for 2 or 3 days before the operation. If there is any indication of deficiency of the liver function carbohydrates and water are freely administered by the mouth and a 5 per cent solution of glucose is given by the rectum.



Fig 1 Anatomy of the biliary apparatus. Stones are shown in the cystic duct, common bile duct, and ampulla of Vater. The pancreatic duct of Wirsung and the accessory duct of Santorini are shown the latter opening separately into the duodenum.

The day before the operation the skin of the abdomen is shaved, a warm bath is given and, later, the abdomen is painted with tincture of iodine, no compress is applied. The skin is again painted with iodine when the patient is on the operating table.

#### OPERATION

In order to render the parts more accessible, the bridge or cushion is raised under the patient's back at the level of the liver. This brings the common duct two or three inches nearer to the surface, and also tends to open out the costal angle and displace the intestines downward away from the liver. The patient's head is raised and his thighs somewhat flexed to relax the recti.

I believe that Kocher's incision is the best for this operation (Fig 3). It starts just below the tip of the ensiform cartilage and runs obliquely downward and to the right,  $1\frac{1}{2}$  inches below the costal margin. It descends a little toward its outer end and completely divides both the muscular fibers and the fibrous sheath of the right rectus muscle. Cutting across the rectus sheath gives far better access than vertical slitting. If necessary, the incision may be prolonged slightly into the muscular fibers of the external oblique without dividing any of the intercostal nerves. This gives

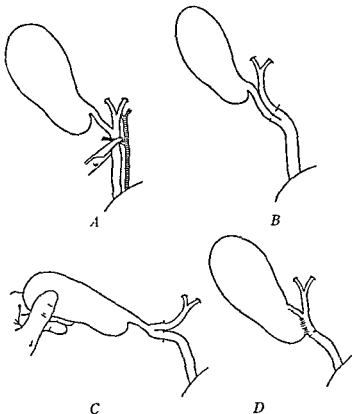


Fig 2 A Common bile duct clamped with abnormal cystic artery. B Division of common hepatic duct with parallel adherent cystic duct. C Traction causing dangerous looping of common bile duct. D Hartmann's pouch or pelvis of full gall bladder adherent to the common duct (After A. J. Walton).



Fig 3 Kocher's incision. A. All the fibers of the right rectus but no important nerves are divided although the incision may be prolonged across the linea alba and outward into the external oblique muscle.

a direct and wonderful view, almost abolishes the need of retractors, and the lower edge of the incision keeps the intestines from prolapsing. Hernia is very rare after this incision, even when drainage has to be adopted (Fig 4).

Every bleeding vessel is immediately tied with fine catgut and the transversalis and peritoneum are incised freely. The falciform ligament is also clamped and divided if necessary. The abdomen is rapidly explored unless there is some contraindication, and the whole biliary apparatus is always carefully examined, for it is vital to determine if the common bile duct is normal, to see if its

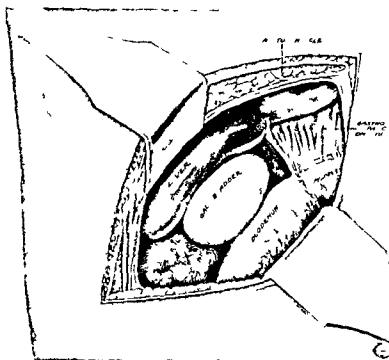


Fig. 4. Kocher's oblique incision across the rectus abdominis.

first part above the duodenum is dilated or not and to palpate its second and third parts, the head of the pancreas and the duodenal papilla for stone induration or growth.

If the disease is limited to the gall bladder and removal of the gall bladder is considered necessary after due deliberation the liver is displaced downward and rotated if possible. A gauze pack is placed above and behind it if necessary to retain it in this advantageous position. A dry gauze roll is carefully packed into the right kidney pouch and a large aseptic pad with tape attached is fixed at the inner part of the wound to protect the stomach and duodenum. When the gall bladder has been carefully freed from adhesions to the omentum, colon or duodenum its fundus (and often its dilated prolapsed pelvis also) is seized with forceps and drawn forward by an assistant while the surgeon exposes the cystic duct by incising the peritoneal fold extending from the gall bladder to the front margin of the foramen of Winslow. When the gall bladder is large distended and folded downward awkwardly at the neck it is first emptied with a trocar and cannula, and the opening is carefully closed by clamping.

Careful blunt dissection soon displays the duct and, to avoid any chance of error, the duct must

be followed from the gall bladder to its junction with the common bile and common hepatic ducts which must be clearly displayed. For this patience and a good light are essential. When the cystic duct has been carefully dissected out of its bed it is tied with catgut about a quarter of an inch from its termination and divided between the ligature and a firm long handled curved clamp which prevents leaking from the gall bladder and is useful for gentle traction. The cystic artery and vein are similarly isolated tied and divided as they pass forward usually between the cystic duct and the liver. The greatest care is necessary to avoid clamping or wounding the common hepatic duct, its right tributary or an accessory right hepatic duct. It is all too easy to injure these particularly if the gall bladder is distended or folded at its neck and the connective tissues in the portal fissure inflamed, oedematous or indurated. This danger is increased if the cystic artery is not well secured but is carelessly divided and allowed to retract and bleed in the depth of the wound (Figs. 2 and 5).

The gall bladder is now separated from the liver from behind forward by blunt dissection with the finger. The peritoneal covering is saved as far as possible until the separation is nearly completed. It is then so divided with scissors that

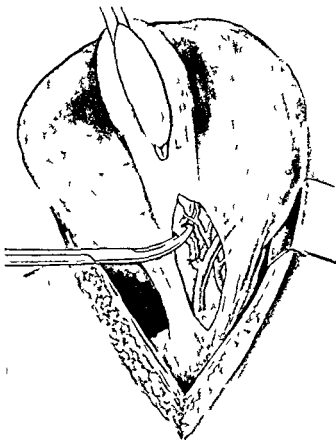


Fig 5 Cholecystectomy The cystic duct has been tied and clamped The gall bladder is held up with forceps

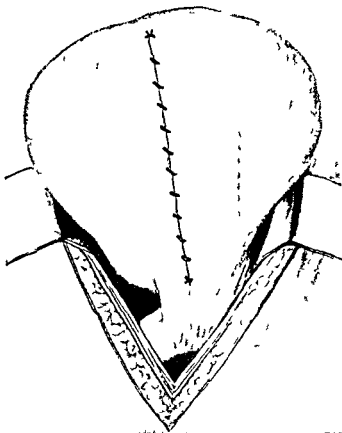


Fig 6 Cholecystectomy The operation completed by suture of the peritoneum over the raw surface of the liver

the edges can be sewn together to cover the raw surface of the liver. This arrests hemorrhage from the liver and minimizes adhesions. Occasionally, when there are very dense adhesions about the neck of the gall bladder, it may be safer to separate it from before backward, but as a rule this is more tedious and causes more bleeding. Rarely it is safer to open the bladder along its inferior surface and to trace its mucous membrane back to the cystic duct.

The stump of the cystic duct is buried and the raw surface of the liver covered by sewing flaps of the peritoneum over them (Fig 6). Unless all oozing has been stopped, it is wise to drain the wound at its outer angle with a small short, soft rubber tube for 36 hours.

The bridge is let down and the parietal wound is accurately closed in layers as follows:

A continuous suture of No. 2 formalized catgut is begun at the inner angle of the wound and, picking up the peritoneum, aponeurosis and the deeper half of the rectus muscle, it is continued to the outer angle of the wound, then, picking up the anterior aponeurosis and the anterior fibers of the rectus, it is carried back to the inner end of the wound and tied there. Three or four mattress

supporting sutures of No. 2 catgut are then placed in the rectus sheath and muscle. The skin is closed with a continuous suture of fine linen thread. The rubber tube is sewn to the skin at the outer angle of the wound.

#### AFTER TREATMENT

If all goes well, the drainage tube is removed at the end of 36 hours. As a rule the wound needs no further attention until the stitches are removed at the end of a week. The patient is encouraged to move about in bed from the beginning, often sitting up during the day, in an oblique position, and lying down at night, on one side or the other, change of position and movements are insisted upon, as are breathing exercises. Especial care is taken to see that the bandages are never tight across the lower part of the chest. As a rule the patient is allowed out of bed, and to stand and walk a little, on the fourth or fifth day, and is generally able to leave the Hospital or Nursing Home after 2 or 3 weeks. He is advised to take a holiday of a month or six weeks, with gradually increasing exercise, at the end of which time he should be fit to return to work and his normal mode of life.

Gentle exercise (especially movements of the trunk in all directions) are encouraged from the beginning with the idea of preventing stiffness from adhesions in the right flank. Occasionally adhesions cause trouble by engaging the duodenum or pylorus thus causing partial pyloric obstruction but much can be done to avoid this complication by carefully covering the defect on the under surface of the liver by sewing the peritoneum as indicated in Figure 6 or by using flaps of great omentum to cover this area.

Patients do remarkably well after cholecystectomy and are peculiarly free from the recurrence of symptoms which so commonly follows cholecystostomy. The mortality of the operation is from 1 to 2 per cent.

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## PLASTIC RECONSTRUCTION OF THE AXILLA IN THE OPERATION FOR CANCER OF THE BREAST

REPORT OF THE AUTHOR'S FIRST FIFTY CASES<sup>1</sup>

By WILLIAM T. COUGHLIN, M.D., St. Louis, Missouri

THE greatest advance that has been made in the treatment of cancer of the breast is due to William S. Halsted. We might contrast the prognosis of breast cancer surgery before and since his publication of 1894 just as is sometimes done of surgery before and since Pasteur.

In pre-Halsted days recurrence of the cancer was the rule, now it is rather the exception. "The younger Gross did not save one in his first hundred cases, Sands had never saved one, and Agnew believed that the operation always shortened life." Velpeau had recorded 170 cases and only 7 of them lived more than 5 years. Billroth acknowledged 85 per cent recurrence, Bergman 51 per cent, and the results of all of the other celebrated German surgeons lay somewhere between these figures.

Now by recurrence is meant return of the carcinoma in the scar or in the field of operation. Billroth thought that if no nodule could be palpated at the end of a year the case was cured, but Volkmann thought that none should be pronounced cured until after 3 years' freedom from recurrence. I wonder how many of those who read this would be willing to pronounce any of his former patients cured! that is, certain never to die as a consequence of that cancer long since removed.

Volkmann advised the removal of the axillary glands when these were palpably involved but to Kuester belongs the credit of being the first to advocate their removal in all cases—whether they were palpably involved or not. Kuester also had removed both pectorals in the worst cases (38 with 13 recurrences). He advised going wide of the cancer, and he advocated removal of the fascia covering the pectoral muscles in all cases—he had found cancer cells spreading out over the surface (a lymph space?) and infiltrating the fascia and even the muscle.

The name of Heidenhain is one that we should respect as much as, if not more than that of Halsted, Volkmann or Kuester.

Working in Kuester's clinic Heidenhain was struck by the extraordinary frequency of recurrence after operations for cancer of the breast. Investigating he found that the poor results were

not confined to the clinic of Kuester. The published results gave the combined average for the German surgeons as "freedom from recurrence after 3 years only 17.2 per cent."

Heidenhain was the first to insist that recurrence meant inefficient operation. He made a microscopic study of sections from the cut surfaces of 18 breasts removed by Kuester and was able correctly to forecast recurrence before this took place, in those cases in which the cut edge showed cancer infiltration.

Halsted insisted that recurrence in the scar must be the result of poor surgery although no one could be blamed if recurrence took place in the skin nearby. Willy Meyer published his method very shortly after that of Halsted appeared. He advocated the removal of both *pectoral muscles*, and gave credit for the idea to Gerster (1885). Halsted advocated the removal of the sternal part of the pectoralis major, working from within outward and doing the axilla last. Meyer advised first cleaning out the axilla and then removing the breast. Therefore it will be seen that now when we do the "complete Halsted" we do "Willy Meyer's operation."

For comparison one should refer to the present status of the surgery of carcinoma of the breast. I think the recent publication of the conclusions of the Committee on Cancer of the British Ministry of Health will just about tell the story for surgery the world over.

"The average expectation of life for a woman with cancer of the breast, without operation, is 3.25 years. Those operated upon may be classed average and best cases. The average person comes for treatment more than 1 year after discovery of the lump, the average duration of life is 5.74 years. Even in these the expectation of life has been more than doubled."

The best have no glandular or skin involvement and of those 85 per cent remain free from recurrence after 10 years.

Still our results are not perfect, and we must constantly try to better them. Early diagnosis and still earlier removal must be our aim. We should insist on one short and simple answer to the question "How do you make a diagnosis of early cancer of the breast?" and that answer

<sup>1</sup>Read before the Western Surgical Association at Duluth, Minnesota, October 15, 1916.





Fig. 1 The incision used by the author when the original tumor is situated in the breast as in the ordinary case. The arm is abducted and the upper transverse incision reaches from the middle of the clavicle to the posterior axillary line crossing the axilla keeping away about 1 inch from the arm.



Fig. 2 The skin flaps are reflected. The blade of the knife should be turned away from the skin (the artist has made a mistake) cutting parallel with the skin and not more than a quarter of an inch away from it. The skin is reflected to beyond the opposite parasternal line above the clavicle well out onto the shoulder beyond the first incision and back to the posterior axillary line on the same side. The bleeding is controlled by hot wet towels packed in as one goes along.

should be. By early removal of the lump and its microscopic examination.

As an interne it fell to my lot to dress certain cases on which the Halsted operation had been done. The space bridged by loose and baggy skin reaching from the chest wall to the shoulder and arm never failed to become infected and suffering and disability were the rule. Many have been the expedients tried in order to get this skin to lie close against the vessels throughout their course and to prevent the formation of dead space especially when the arm was abducted. None of the accepted incisions has ever allowed this to be done successfully.

You have noticed how the tailor in fitting you uses two flaps to draw the cloth close into the axilla—if we can fashion our flaps somewhat on his lines our problem is solved.

The author has been using the method here described and advocated since 1910. In a previous communication the method was published

and the cases reported and now after having used the method in over 50 cases the results are published in order that the method may be given a trial if it is considered worthy, perhaps by those having a wider experience.

Usually there is too much skin remaining out toward the axilla. If there is anything in Handley's theory of the spread of carcinoma the presence of the strip extending from breast to axilla is a menace. Rodman must have believed this.

The incision from mid clavicle to posterior axillary line or beyond follows a straight line. As it crosses the base of the axilla it is not more than 1 inch from the arm as this lies alongside the body. The posterior flap is grasped at its tip (which should be rounded and drawn hard up toward the clavicle, the higher the better) and fastened there. No room is left for a drain in the fornx under the flap. If this flap heals where it is



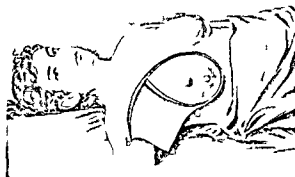


Fig. 5 Halsted's original incision (From Ann Surg 1904 xx 497)

a case from shock during the evening following operation. But in 1925 I lost 3 patients certainly as a result of shock. The third patient having rallied was found during the night to have a temperature above 100 degrees F. It was very hot weather. She lived 3 days delirious though her hands and feet died the second day (turned black). The pathologist found fibrinous peritonitis and a recent perforation of the lower ileum. There had been no abdominal symptoms whatever.

#### INFECTION

There has never been an infection in any of our cases in which the complete operation has been done.

Our method of closure minimizes the amount of dead space and hence lessens the liability to post-operative infection. This perhaps is not much of an advantage to surgeons who can do their own dressings. But when dressing must be left to an assistant anything that makes it safer is of course of distinct value.

#### COMPLICATIONS

Pneumonia occurred once in a fat patient 49 years old. The operation had taken 3 hours and 20 minutes. The neck had been dissected and the cautery had been used to sear the chest wall. The woman developed a cough and purulent streptococcus bronchitis. After the wound had healed and all sutures were out she fell out of bed while the nurse was sleeping and tore the axilla open again. She died after 4 weeks, no post-mortem and no roentgenograms of the chest (1916) being made.

#### RECURRENT

By recurrence is meant re appearance of the cancer in some part of the area from which it is supposed to have been removed. Its first mani-

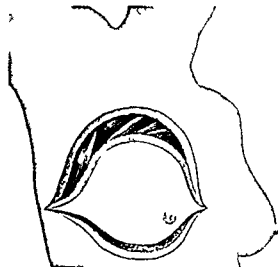


Fig. 6 Stewart's original incision (From Ann Surg 1915 lvi 230)

festation is a lump either in the scar or under the skin flaps. Recurrence is of two kinds that which appears in the operative area only and that appearing in the operative area and elsewhere in the body. This last form of recurrence is in my opinion just a part of the general dissemination. Of the first variety that which ensues because of incomplete removal or faulty handling there have been 6 cases.

One of these cases has an interesting history. A strong rather lean married woman of 40 with 2 children both breast fed was operated upon in 1912 for a tumor the size of a walnut in the right breast. It was a cirrus and the breast showed chronic interstitial mastitis. The glands were negative. One year later a nodule appeared just below the clavicle and I removed it. It was necessary to resect about 1½ inches of the axillary vein. I charred the clavicle with the cautery and cleaned out the neck. In 1920 she came with a lump in the left breast. I removed the lump and another pathologist pronounced it 'sub involution with cyst formation'. I then removed the breast and the lowermost axillary glands. One year later she came with a nodule under the flap. I removed it and the same pathologist re-examined it and reported scirrus carcinoma of the breast. She is still quite well.

Another patient came back in a year with a hard nodule fixed to the second rib near the sternum. The cancer was of scirrus type and had been present over a year before operation. It was the size of a hen's egg. The axillary glands were involved and the nodule was cancerous. I

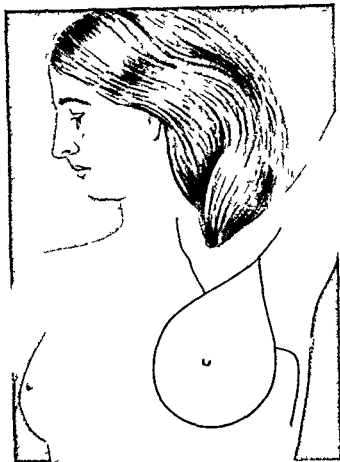


Fig 7 J C Warren's original incision (From *Ann Surg*, 1904, vi 803)

cooked it well and then removed the portion of the rib involved and let it heal by granulation. The patient is well after 5 years.

Another patient, aged 40, fat, nursing a first baby of 6 months, discovered a nodule. She had it removed with a paste. It recurred in 7 months. I then did a complete operation. The axillary glands were involved. I later removed the lower glands of the neck. The lowermost showed carcinoma. One year later a nodule appeared in the skin of the neck in the angle between sternomastoid and clavicle. This was diagnosed as adenocarcinoma of the breast. She is well now after almost 3 years.

Two patients have had recurrence in the intercostal spaces close to the sternum. In both cases I cauterized and cut and am using the X rays. One of them is now better than she was 2 years ago when 1 year after operation she came back with the recurrence, the other was operated upon only 4 months ago and her cancer is growing. The sixth returned in 6 months with cancerous nodules everywhere in the operated area, also in the skin of the back (same side) to within a hand breadth of the spine. She did not live



Fig 8 J N Jackson's original incision (From *J Am M Ass*, 1906 xvi, 627)

a year altogether (10 months after her first operation).

In 4 of those in whom recurrence took place in the field of operation sometime after evident widespread metastases, 1 lived 2 years, the others were dead within a year after operation.

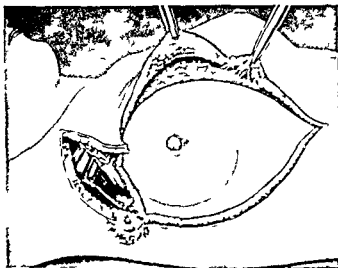


Fig 9 Rodman's original incision (From Rodman, *Diseases of the Breast*, 1908)

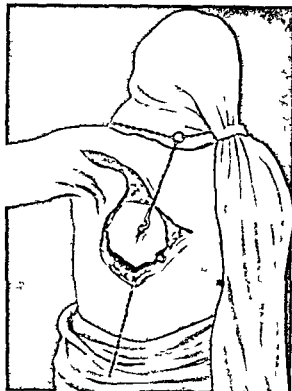


Fig. 10. Willy Meyer's original incision. (From Med Rec 1894 74( J Am M Ass 1903 xlv 297)

I believe that in these cases the recurrence is a part of general dissemination which occurs before operation

#### METASTASES

One thing that surprised me very much indeed was the frequency of metastases to the spine. I have had in this series 6 such cases and I have encountered perhaps as many more in consultation. I was also somewhat startled to learn that metastases to the spine might come late and be limited to one spot as seen by the following case.

Mrs H, 56, a working widow, knew of the lump in the right breast for a year or so. It was as large as a turkey's egg and axillary glands were involved. She too was fat. The type was adenocarcinoma. She was operated upon in 1914 and was quite well until 1921 when she developed lumbago. She died late in 1922 having lived about 8½ years. The postmortem was complete and the only cancer anywhere to be found was where the fourth lumbar vertebra had been.

Another patient lived 6 years and then developed spinal metastases (presumably). None of the others with spinal metastases lived more than 2 years.



Fig. 11. Sampson Handley's original incision. (From Brit M J 1904 ii 832)

I have learned that when a patient formerly operated upon for cancer of the breast develops chronic rheumatism or lumbago to suspect metastases to the spine or pelvis as the cause of the condition.

In a case of rapidly growing adenocarcinoma in a girl of 16 the tumor had been noticed more than a year and in the past 3 months had grown from a nodule the size of an olive to a mass larger than the other breast. It was quite 4 inches across and lay to the inner side of the breast. The skin over it was warmer than that elsewhere and the veins were enlarged and tortuous over it. It felt like a lipoma but harder. It was encapsulated. But owing to the microscopic appearance and the history of rapid growth a complete operation was done. The glands were negative. She is well 3½ years later.

#### SUMMARY

There have been 50 operations and in 10 cases only 2 years or less have elapsed since the date of operation.

Of the 50 cases there were 5 deaths in the hospital after operation. The cause of death was shock in 3, heat stroke in 1, gas gangrene in 1 and pneumonia in 1; an operative mortality of 12 per cent.

Of the 40 operated upon more than 2 years ago, 24 are now living and 16 are dead

Of the 16 patients who died, 3 died in the hospital after operation, 1 as the result of gas gangrene, 1 of pneumonia, and 1 of shock. One patient died 3 years after operation of pneumonia. In 12 cases the cause of death is known or believed to have been cancer. That is to say, 3 out of the 40 died as a result of the operation and 25 out of 37 are believed to have died of cancer.

Of the 24 living, 1 has been living 13 years, 2 for 11 years, 1 for 10 years, 3 for 7 years, 1 for 6 years, 4 for 5 years, 8 for 4 years, 4 for 3 years. Of those who died of cancer since operation, 1 lived 8½ years, 1, 6 years, 1, 4 years, 4, 2 years, 3, 1 year, 2, less than 1 year.

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# CLEFT PALATE REPAIR—THE CAUSE OF FAILURE IN INFANTS AND ITS PREVENTION

By STERLING BUNNELL M.D. SAN FRANCISCO

THE main cause of failure in repairing cleft palates especially in infants is the sucking action of the tongue. Having become convinced of that fact I devised the following means of keeping the tongue away from the palate and since their adoption have found that repairs have been successful.

Before using the method I found it almost the rule in infants for the palates to partially break down in the first or second week after the repair. Even after the closing of the palate in a way that seemed surgically correct that is by using massive flaps with good blood supply with exact apposition and freedom from tension it was usual in infants for the suture line to break down either in its posterior half or in its center in a varying number of days. Then as the palate healed the result improved a little as the contraction of the scar in the cleft drew the closed apex of the cleft backward much like the tendency for webs to reform after some operations for syndactylism. Thus after repeated operations the palate was finally closed but was then often found to be short so that in speech or deglutition it did not act well as a valve to shut off the nasopharynx.

The sucking power of an infant is surprisingly great as is easily demonstrated by feeling the pull exerted on a finger inserted in a baby's mouth. As measured by a manometer on a series of newborn babies this force averaged 152 millimeters mercury the highest being 200 millimeters. In adults it averaged 440 millimeters. From this it is readily calculated that the force exerted on the palate in the average newborn infant is 7 ounces times the number of square centimeters of the palate that are involved in the sucking

$$\frac{13.6 \text{ (Wgt. of Hg)} \times 15.2 \text{ (height of col. in cm)}}{30 \text{ (No. of gm. in 31)}} = 7 \text{ oz}$$

The infant whose palate has been recently operated upon will probably not suck with the same great strength of the normal infant but it will suck with a formidable proportion of this strength in spite of the pain. Is it then surprising that our sutures in such a delicate structure as a baby's palate cannot withstand this repeated trauma and strain? While the palate remains completely united the strain of the suction between it and the

tongue is great but as soon as any part of the suture line gives way the suction is broken in part at least. For this reason it is rare for the complete length of the suture line to hold after an operation done in the sucking age which is, in the first 16 months. Even in young children the constant and uncontrolled action of this strong and muscular organ, the tongue jeopardizes our surgical repair.

It is advisable to close the cleft in the palate at a very early age and the method about to be described makes this possible. Nutrition is then improved by normal nursing and feeding. The correct habit of modifying vocal sounds which attainment is our main object in repairing palates is then established early, long before articulate words can be produced. The earlier the palate is closed the better will it develop as in the first years of life there is the greatest growth. Also the earlier the repair the less is the mental anguish of the parents. Surgeons have found by experience that a delay of operation even as long as for a few years increases the probability of success in obtaining a closure. Brophy whose experience is great stresses the need of closing the cleft early that is between the sixteenth and twenty-second months so that correct habits of articulation will be formed as speech starts. He delays operation until that time because as he states 'The mucoperiosteum removed from the bones is frail and likely to break down.'

The method to be described will allow closure of the palate during the first few months of life and will improve the result of operation done at any age.

## PRELIMINARY PROCEDURES

Soon after birth the alveolar processes are pressed into alignment and held there by Brophy's method of wires and plates. In from two weeks to a month as soon as the baby has a grip on life the lip is repaired. The first is a minor procedure but the repair of the lip and nose is attended by even more hemorrhage than is the repair of a palate and so may prove fatal especially if the baby, as is often the case, has malnutrition. A 50 cubic centimeter Luer syringeful of the mother's blood transfused with an ordinary



Fig 1

Fig 1 Metal spoon for holding the warm dental wax up against the alveolus to make the wax impression



Fig 2

Fig 2 The wax impression of the alveolus



Fig 3

Fig 3 The dental artificial stone has been poured into the wax impression which is perfected by working the wax all around the alveolus with the fingers

needle by cutting down on the baby's median basilic vein immediately postoperatively will prevent death from hemorrhage. Such a small amount of blood can be given by this simple method before it has time to clot in the needle. One should always at the end of each operation suspend the baby by the feet to pour the blood and mucus out of its trachea as a baby cannot cough it up. One to three months later when the baby is strong enough, the palate can be closed. This is done in two stages, a week apart, in order to have time to make our protecting false palate and to gain the advantage of a certain principle established in plastic surgery.

In this, the mucoperiosteal flaps are separated from the bone sufficiently to reach together without tension and are then immediately replaced to where they were without sutures, and left for a week. Lateral freeing incisions are avoided when possible and are never extended backward through the muscles and vessels of the soft palate. At the end of the week the blood vessels in the pedicles will have increased in capacity so that the flaps will be sufficiently viable to more readily stand being moved from their beds and sutured together. The flaps will also be found to be much thicker. One stroke of a blunt instrument will free them from their beds, with very little bleeding. Their edges are trimmed off and sutured with horsehair. The wires and thin metal plates of Brophy can also be used on the soft palate.

#### THE PROTECTING FALSE PALATE

In order to protect the palate from the damaging action of the tongue a metal false palate prepared from an impression of the baby's mouth (Figs 5, 6, and 7) is held in place up against the alveolus under the palate to wall off the tongue during healing.

At the first stage of the operation before the flaps are freed, an impression of the alveolus and palate is made with dental wax by the usual method used by dentists. The wax softened in warm water is placed on a spoon-like sheet of aluminum fashioned to fit the alveolus (Fig 1) and is pressed by the finger held under this spoon against the roof of the mouth. The wax is worked all around the alveolus by fingers pressing through the cheeks and lip.

In the interval between the two stages of the operation, the protecting false palate is prepared. First, a counter impression from the wax is made with dental "artificial stone" (Figs 3 and 4). From this a false palate of sheet silver (gauge 28) is made in a dental laboratory. Soldered to it are two silver wires (gauge 16) which are made to run directly downward from the region of the lateral incisors and are later bent to fit the baby's face. Multiple perforations are made in



Fig 4 The counter impression of artificial stone ready to send to the dental laboratory as the form of the alveolus for making the protecting false palate of silver. The area where the silver false palate is to make contact with the patient's alveolus has been marked with crayon.





Fig 5



Fig 6



Fig 7



Fig 8



Fig 9



Fig 10



Fig 11



Fig 12



Fig 13

Figs 5, 6 and 7 Showing the finished protecting false palate of silver with wires attached and bent into position. The silver plate is ready to be held up against the alveolus by rubber bands attached to the hooks on the wires. The views are top, front and diagonal respectively.

Figs 8 to 13 Showing the protecting false palate of silver held in place by thin rubber bands to the plaster bandage which encircles the head. The repaired palate is thus protected from the sucking action of the tongue for 12 days while the suture line is healing. The photographs also show the results on the harelips and nasal deformities which were repaired before operation on the palates.

the false palate so that a screen effect is produced for drainage.

On the completion of the second stage of the operation, in which the palate is repaired, a plaster of Paris band is placed about the baby's head and incorporated in this in a frontal plane with the center of the palate are placed wire hooklets, each for the attachment of a narrow rubber band, such as druggists use. The protecting false palate is then placed under the upper alveolus and the stiff wires are bent around to fit the face and to hook over the two rubber bands that hang from the plaster head band. By these bands the plate is gently held in place against the alveolus protecting but not touching the sutured palate. The wires should be so bent that they emerge from the mouth so as not to touch the lips. Then each wire is made to pass laterally around the outside of the cheek, and then to bend vertically upward and terminate in a hook for the attachment of the rubber band. The hooks of the wires should be in such a frontal plane with the center of the palate that the plate is lifted up against the alveolus with equal pressure in both its front and back parts.

The baby's arms, with elbows extended, should be encased in plaster of Paris.

The surgeon's mind will then rest assured that the tongue, which is the arch enemy of the

repair of the palate, will not break down his handiwork.

In the after treatment great care must be maintained to insure cleanliness. It is advisable to have a special nurse, but if this is impossible, each and every floor nurse attending the baby should be carefully instructed how to clean and guard the palate from injury. After each feeding the false palate should be lowered vertically and kept in a parallel plane with the palate, to allow the plate and palate to be irrigated. The top of the plate should be sponged off with a cotton swab daily and by touching the suture line and surroundings every few days with a 1 per cent alcoholic solution of brilliant green and crystal violet, necrotic material may be rendered inert as a culture media. With this care, the baby's mouth can readily be kept clean and free from odor. Feeding is done through a catheter introduced to the pharynx.

The stitches are removed on the twelfth day under anaesthesia and the false palate is left in place 2 days longer.

Since the above method has been in use it has been a satisfaction in each successive case to see the repair of the palate hold throughout its entirety, while before the adoption of the method, almost invariably the palate when repaired in infants broke down, at least in part.

## THE IDEAL IN HERNIOGRAPHY

## A NEW METHOD EFFICIENT FOR DIRECT AND INDIRECT INGUINAL HERNIA

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## SKIN INCISION

THE incision for inguinal hernia should be in the line of skin cleavage or nearly transverse. Oblique incisions, flap incisions, or those that invade the scrotum usually give a poor scar and are unnecessarily mutilative. The art of surgery should not be disregarded even in an abdominal incision for artistry in a surgeon's scars is apt to mirror artistic skill throughout the operation. A badly made crudely sutured skin incision of the abdomen at once suggests and often correctly a weakened abdominal wall or incisional hernia, intra-abdominal adhesions, and other evidence of technical defect in the operation.

If a previous operation has been done in the same field, the old scar should be excised to give the operative approach. It is a curious mutilative impulse that impels the operator to insist on making a fresh incision in spite of the presence of one or more disfiguring scars in the neighborhood of the operation.

Art necessitates the taking of pains in one's work. Desire for personal convenience, expedition, ease cannot excuse a poorly placed and crudely closed wound when the patient's safety is not involved. Scrotal incisions involve an area difficult to sterilize.

A normal incision for inguinal hernia, therefore, is one which passes transversely directly over the internal inguinal ring from a point just within the semilunar line to a point slightly external to Poupart's ligament (Fig. 1).

## SPLITTING THE EXTERNAL OBLIQUE APONEUROSIS

The thinnest and weakest portion of the external oblique muscle lies over the inguinal canal. If the fibers are split above or below the line of the canal, one flap will have toward its base the weak area. If the fibers are separated directly over the canal, the edges of the flaps or the parts best supported in the closure will be weakest, which makes for the strongest mechanical closure of overlapping edges. If the separation is made by scissors or with a grooved director, the underlying iliohypogastric nerve may be caught and divided. Therefore, the external oblique should be carefully split by a scalpel from without inward between

the thinnest and most widely separated fibers that are found over the hernial canal.

The outer surface of the external oblique should not be freed from adherent fascia and nutrient vessels but the under surface should be freely separated by blunt dissection from the underlying internal oblique muscle and from the inner anterior layer of the sheath of the rectus to the midline. This mobilization of the deeper muscular layers is of great advantage in enabling a satisfactory closure of the canal and the freeing of the rectus has been especially emphasized by De Guerno. The inner and shelving portions of Poupart's ligament should be wiped free from all fat and adventitious tissue by a gauze sponge.

## OPENING THE HERNIAL SAC

The hernial sac should be approached from without inward from above downward in the canal and near the internal ring. If one's arches in the region of the external ring or scrotum he may be below a small sac. In approaching the sac, tissues are picked up and divided between hemostats. The hemostats should not crush vessels or nerves and are not to be removed until the sac has been located and opened. Each layer invaded should be indicated by an additional pair of hemostats. In this way the operator has a means for identifying each layer entered and does not repeatedly pick up, explore, and re-explore the same tissue. The tissue layers to which tissue forceps have been attached are avoided until the sac is opened when the forceps are removed. The operator should not raise the cord or explore tissue behind the cord. If the sac is not promptly found, he should not continue to traumatize the region of the cord but by retracting the internal oblique and transversalis upward and outward, expose and open the peritoneum just mesial to the internal ring. Then with an exploring finger within the peritoneum the problem is immediately solved. A very thin collapsed sac, a small incomplete hernia, a direct hernia, a femoral hernia, a wide and bulging conjoined tendon or other condition may be found. In any case when the sac is opened, it is wise to introduce the finger and examine for any other sac or weakness or other adjacent interabdominal di-

such as an inflamed tube or appendix. A number of recurrences after herniorrhaphy have been due to an overlooked sac which such an examination would have instantly revealed.

#### TREATMENT OF THE SPERMATIC CORD

Transplantation of the spermatic cord is not essential in the successful operative treatment of inguinal hernia. The older statistics of Bloodgood, in which 500 cases without cord transplantation showed slightly better results than 500 cases with transplantation, are not unusual. Naturally, a poorly performed operation without the transplantation should not be expected to compete with a better technique and transplantation. The surgeon partisan to and especially experienced in the Bassini operation may personally have better results than with his own non-transplanting operation, but his results should be compared with those of a surgeon especially skilled in the non-transplanting technique.

A personal experience is illuminating in this regard. In over 3,000 inguinal herniorrhaphies only 11 patients have returned for recurrence. Four of these were strictly not recurrences, but consisted of persistent direct inguinal hernias, not recognized and not corrected at the first operation. The true recurrences followed unusual physical strain during the first week or weeks of convalescence, a violent postoperative cough being a common factor, obese and asthmatic middle aged patients giving the chief trouble. Thus the recurrences started before firm union had occurred in the deeper layers of the wound. It is reasonable to believe that were the recurrences due to failure to transplant the cord, or other technical defects, some would have been delayed for months after an uneventful operative convalescence, just as we so often find in the recurrent hernias after Bassini's operation. Furthermore, in these patients returning with recurrence, as well as the much larger number treated for recurrence after the Bassini operation, transplantation of the cord has not been found necessary for the final successful result. One apparent secondary recurrence has been observed. The first operator did a Bassini operation, but overlooked a direct hernia. At the re-operation the cord was also replaced but the direct hernia again overlooked. At the third operation the direct hernia was found and successfully corrected without retransplanting the cord. No other instance has been observed in which the technique here given has failed at the second operation.

By leaving the cord alone one eliminates most of the postoperative complications in the scrotum

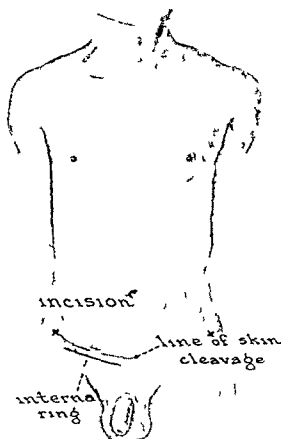


Fig. 1. Line of incision for herniorrhaphy. A nearly transverse incision 10 to 14 centimeters long, centering over the internal inguinal ring. This involves a portion of the abdominal wall easily sterilized and gives a linear almost invisible scar.

As a rule, it is also important not to injure or ligate the spermatic veins. In one case in which a swollen testicle was explored after ligation of two-thirds of the veins for varicocele, the gland was found to be necrotic. Bloodgood has emphasized this danger. Therefore, transplantation or manipulation of the spermatic cord is usually unnecessary and undesirable in the operative treatment of inguinal hernia.

#### TREATMENT OF THE HERNIAL SAC

The hernial sac should be eliminated, especially its funnel like mouth, and the neck of the sac should be transplanted behind a part of the abdominal wall that is strong and thick. The inversion of the sac advocated by Kocher need not be practiced, but his idea of transplantation of the neck of the sac is important. In congenital and infantile hernias, and in certain sliding and very large scrotal hernias, division of the neck and retention of the body of the sac in the scrotum are desirable.

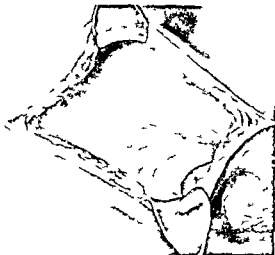


Fig. 2 Division of superficial (fascia of Camper) and deep fascia (fascia of Scarpa) showing enlarged external inguinal ring and bulging anterior wall of inguinal canal with darker triangular area marking the thinner portion of the aponeurosis of the external oblique over the inguinal canal where the fibers have been separated

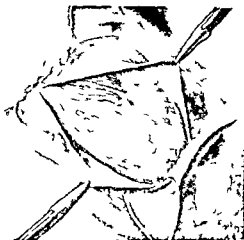


Fig. 3 Separation of the fibers of the external oblique aponeurosis directly over the canal from the external inguinal ring upward and outward exposing the internal oblique muscle the cremaster muscle the hernial sac and perimatic cord

#### DEEP SUTURE MATERIAL

Good chromicized catgut is entirely efficient for the deep closure in herniorrhaphy. Its desirable lengths smoothness strength and absorbability give it advantages over other known suture materials. Kangaroo tendon is no longer necessary for a successful closure. Aseptic silk and strips of homologous fascia produce less tissue reaction but have compensating disadvantages.

#### LAYER SUTURE

Strength in the union of the layers of the abdominal wall comes from the fibrous aponeurotic expansions not from the suture of red muscle out of which sutures readily tear. Red muscle gives good support however when backed by a strong fibrous sheath or aponeurosis. Below the chief support is to be obtained from Poupart's ligament its shelving edge and the dense fibrous covering of the pubis above and internally from the conjoint tendon the fibrous inner layer of the anterior sheath of the rectus and the external oblique. Bloodgood's transplantation of the rectus muscle by opening its sheath weakens the wall. Much better is the transplantation of the muscle in the sheath.

#### CLOSURE OF HESSELBACH'S TRIANGLE

In inguinal herniorrhaphy, the most troublesome area of weakness lies in the lower inner angle the area of the conjoint tendon. This is the area that has been difficult to strengthen and it is weakness here that has been responsible for

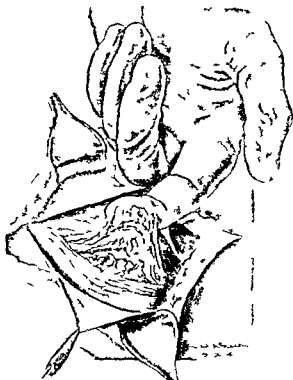


Fig. 4 Hernial sac exposed and raised on the finger showing attached underlying vas deferens. The vas is not transplanted not disturbed and often not seen.

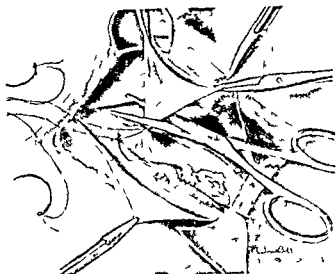


Fig 5 The hernial sac has been opened liberated to the internal ring the contents reduced the neck transfixed and ligated by a double armed suture the ends of which will be used for transplanting the neck of the sac and for closing the inguinal canal

most recurrences. The transversalis fascia and the conjoint tendon are structures of uncertain strength, and often are not to be depended upon. Occasionally operators have registered their discouragement by asserting that many direct inguinal hernias could not be cured by operation. A solution of this problem lies in obliterating Hesslbrach's triangle by uniting the lateral edge of the inner layer of the anterior sheath of the rectus to the dense fibrous covering of the pecten ossis pubis. The pecten ossis pubis is the continuation of the iliopectineal line forming a distinct ridge along the posterior superior margin of the ramus and body of the pubis. It lies about 13 millimeters back of the spine of the pubis, and the bone is here covered by a very dense and strong ligamentous or aponeurotic covering, several millimeters in thickness, which gives a more secure hold for the needle and suture than does the aponeurosis of the external oblique, or the shelving edge of Poupart's ligament. The covering of the bone is reinforced at this point by fibers from the pubic end of Poupart's ligament (ligamentum inguinale), Gimbernat's ligament, Cooper's ligament, the ligament of Henle (falk inguinale) and the ligament of Colles (triangular fascia or ligament inguinale reflexum). This tough ligamentous structure with its firm bony fixation is, therefore, admirably adapted for suture.

#### NARROWING THE INTERNAL ABDOMINAL RING BY SUTURE OF THE TRANSVERSALIS FASCIA

The narrowing of the internal abdominal ring by suture of the transversalis fascia is not dependable

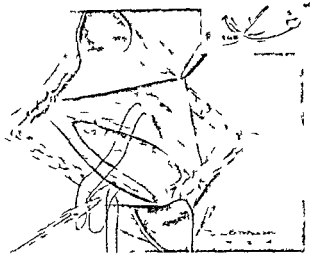


Fig 6 Transplantation of neck of sac and transplantation of rectus muscle. The ends of the ligature from the neck of the hernial sac have been brought through the edge of the rectus muscle and the inner layer of its overlying sheath. The ends of the ligature have then been passed from within out through the shelving edge of Poupart's ligament so that when tied the neck of the hernial sac will be transplanted behind the edge of the rectus and the edge of the rectus in its sheath approximated to the shelving portion of Poupart's ligament. For strength in the closure the sheath of the rectus is not opened.

and may be ignored. Often the transversalis fascia is so thin and tenuous as to be exposed with difficulty, and gives little support when sutured. By the suturing of the internal oblique and transversalis muscles to the shelving portion of Poupart's ligament or better, the inner layer of the anterior sheath of the rectus to the shelving portion of Poupart's ligament, a sufficient obliteration of the internal ring is secured. When this union is reinforced by the imbricating of the overlying external oblique, a competent support to the internal ring and inguinal canal is obtained.

#### TECHNIQUE

The steps of the herniorrhaphy are well shown by the accompanying illustrations. The aponeurosis of the external oblique is exposed by nearly a transverse incision following the line of skin cleavage and centering over the internal inguinal ring. The superficial epigastric artery, the superficial external pudic, the recurrent branch of the superficial circumflex iliac vessels are divided between haemostats, the fibers of the external oblique are freely separated over the inguinal canal and the edges reflected. The hernial sac is located, opened, and the contents examined and reduced. The sac is isolated or divided at the neck, and the neck is transfixed and ligated at a high point by a long No. 1 or 2 chromic catgut suture, each end of which is armed by a needle. The needles are

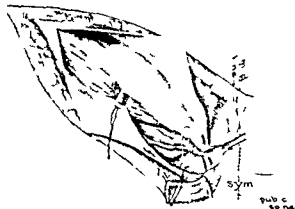


Fig. 7. Obliteration of Hesselbach's triangle. The inner layer of the anterior sheath of the rectus muscle in its lower portion is being sutured to the thick tough ligamentous covering of the posterior superior edge of the pubis posterior to the spine of the pubis and to Poupart's ligament. The helving portion of Poupart's ligament with the attached mattress suture that has served to transplant the neck of the hernial sac is shown.

carried from beneath the transversalis fascia through the edge of the rectus and the suture pulled taut transplanting and pulling the neck of the sac behind the rectus muscle. If the conjoint tendon is weak the upper surface of Poupart's ligament is cleared by gauze dissection the spermatic cord conjoint tendon edge of the rectus and triangular fascia retracted at the inner angle toward the opposite side. The superior surfaces of the body and ramus of the pubis are cleared by gauze dissection above and posterior to the spine of the pubis. The ridge of the pecten ossis pubis is located with its thick fibrous covering and to this the lateral edge of the rectus covered by its inner sheath is sutured by two or more interrupted or mattress sutures. Experience has shown that, if the edge of the rectus is sutured behind the spermatic cord to the fibrous covering of the pubis the cord may be compressed and strangulated. However if the suture is made anterior to the cord there is usually no interference with the circulation. Laterally care should be taken to avoid the femoral vessel. These sutures obliterate Hesselbach's triangle and also effectively close the femoral opening from above. If a femoral hernia is present the sac is entered by opening the peritoneum through the inguinal canal. It is emptied grasped at the fundus by hæmostatic forceps inverted into the wound the neck of the sac transfixed ligated or sutured and the sac removed. Returning to the suture ends from the ligation and transplantation of the neck of the inguinal sac one carries the two

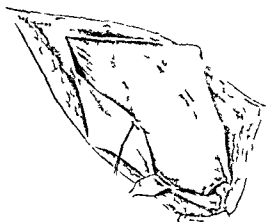


Fig. 8. Obliteration of Hesselbach's triangle continued. The area of the conjoint tendon has been obliterated by suturing the lateral edge of the lower part of the rectus within its sheath to the strong fibrous covering over the pubic portion of the iliopectineal line in front of the spermatic cord. In its mesial portion the suture line lies posterior to the spine of the pubis to the triangular fascia (ligament of Colles or ligament inguinale reflexum). Laterally the suture line is posterior to the umbilical ligament and to Cooper's ligament. These sutures fold the conjoint tendon and the ligament of Henle (fals inguinale) against the pubic bone and the ascending ramus of the pubis. This union strongly blocks the crural canal from above and prevents femoral hernia, reinforcing the weak internal angle of an indirect inguinal hernia and solves the problem of the radical cure of direct inguinal hernia. Care must be taken that the suture line is not carried so far laterally as to impinge on the femoral vessel.

needles through points on the shelving portion of Poupart's ligament corresponding with their points of emergence from the rectus muscle and ties the suture ends. Thus approximates the edge of the rectus muscle covered by the inner layer of its sheath to the shelving portion of Poupart's ligament. From this central point of attachment one suture is continued laterally and upward uniting the internal oblique and transversalis to the shelving portion of Poupart's ligament. Often the muscles show a normal attachment along this line and do not require suture. This is the area where recurrences need not be feared. The other suture is continued medially and downward uniting the inner layer of the anterior sheath of the rectus to Poupart's ligament. The suture of the anterior surface of the rectus at its lower angle to the shelving portion of Poupart's ligament narrows the inguinal canal and crowds into it and toward Poupart's ligament the lower portions of the internal oblique and transversalis. Union between muscle and aponeurosis acquires strength only when the muscle is backed or

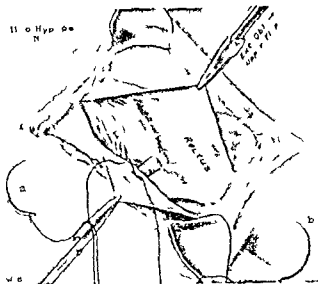


Fig 9. Suturing of internal oblique and transversalis muscles to shelving portion of Poupart's ligament. The suture ends from the ligation and transplantation of the neck of the inguinal sac having been carried through the shelving portion of Poupart's ligament from within out are tied. On suture *a* is continued laterally and upward uniting the internal oblique and transversalis to the shelving portion of Poupart's ligament. Care must be exercised in order not to injure or compress the iliohypogastric nerve. Suture *b* is continued medially and downward uniting the inner layer of the anterior sheath of the rectus to Poupart's ligament.

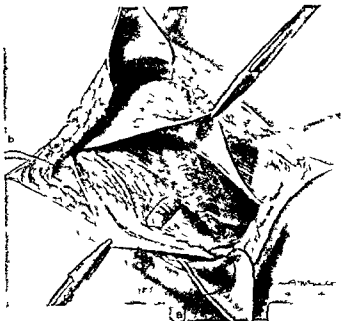


Fig 10. Closure of the internal oblique and transversalis muscles to the shelving portion of Poupart's ligament by a continuous suture completed the ends of the suture being brought through upon the anterior face of Poupart's ligament as shown at *a* and *b*. In this case to prevent undesirable tension the edge of the rectus has not been closely apposed to Poupart's ligament. Usually the inner half of Poupart's ligament can be apposed and sutured to the edge of the rectus sheath. If this cannot be done without undue tension the internal oblique and transversalis muscles are sutured to the shelving portion of Poupart's ligament as indicated. With a strong conjoint tendon the closure of Hesselbach's triangle by suturing the sheath of the rectus to the pubis is unnecessary.



Fig 11. Imbrication of Poupart's ligament by a continuation of one of the sutures. The lower flap of the external oblique aponeurosis including Poupart's ligament covers the previous suture line and is attached to the internal oblique laterally and to the inner layer of the anterior sheath of the rectus medially. The ends of the suture are now brought through the upper flap of the external oblique at its inner angle and tied. Hesselbach's triangle has been reinforced by suture lines with imbrication uniting strong aponeurotic structures in these layers.

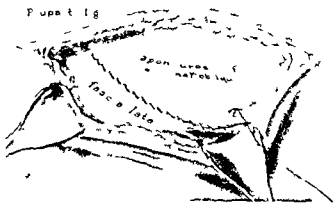


Fig 12. Closure of the aponeurosis of the external oblique muscle. The upper edge of the opening through the aponeurosis of the external oblique has been brought down lapped over Poupart's ligament and the edge sutured to the fascia lata by a continuation of one of the continuous sutures previously used. The neck of the hernial sac has now been transplanted and the inguinal canal narrowed and reinforced by four strong layers of tissue with imbrication.





FIG. 13. Narrowing the external inguinal ring. If the external inguinal ring is large or more than a narrow slit it is reduced in size and reinforced by sewing the edge of the external oblique at the lower angle to the sheath of the pectineus muscle. As a rule this is not required. If the spermatic cord has not been transplanted the projecting spine of the pubis will prevent compression of the associated vessels. Transplantation of the cord is undesirable and should not be used with this technique.

covered by a fibrous aponeurosis. The union of the internal oblique and transversalis to the shelving portion of Poupart's ligament is therefore reinforced by turning up the flap from Poupart's ligament and the lower edge of the divided external oblique and suturing this to the anterior surface of the inner layer of the sheath of the rectus by a continuation of one of the sutures. The upper free edge of the aponeurosis of the external oblique is now pulled down over the preceding suture line and united by its edge to the denuded fascia lata giving a double imbrication. At the lower mesial angle the suture line may be reinforced and the external ring narrowed by suturing the upper edge of the aponeurosis of the external oblique to the sheath of the pectineus by one or two single mattress sutures. Unless there is great weakness this is unnecessary.

The operation may be done with a single double ended continuous suture which is tied at the completion of each row or by partially continuous or interrupted suture according to the operator's fancy. The skin is closed by interrupted or buried sutures or by Michel clips. A thick pad is strapped over the wound and supported by a firm spica bandage which should not compress the abdomen above the level of the iliac crests. The spica is renewed once each week

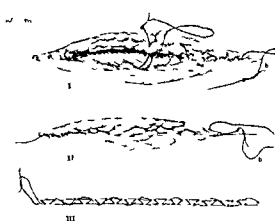


FIG. 14. Closure of the superficial and deep fascia by a continuous buried and intracuticular suture of fine plain catgut, all knots being buried.

or whenever it becomes loosened. The patient is kept flat in bed for from 10 days for children and young robust adults to 18 days for middle aged or senile patients or those with much fat or with poor muscular and aponeurotic development. If the wound becomes indurated or inflamed yellow oxide of mercury ointment is applied and the patient is kept in bed until the induration has subsided.

As a rule the patient leaves the hospital in from 14 to 21 days after the operation with instructions to report weekly or whenever the spica becomes loose for rebandaging to avoid active work for 6 weeks and lifting for 3 months. At the end of 6 weeks all bandages are removed. At the end of 3 months the patient is permitted to do full work.

We believe that a herniorrhaphy properly performed followed by primary union will not break down under any ordinary stress applied later than 6 weeks from the time of operation.

Recurrence not due to defect in technique or in the wound healing usually results from the separation of the lines of suture during the first 2 weeks after the operation caused by severe cough, violent vomiting, persistent hiccough or by the patient sitting up or getting out of bed. Every effort should be made to protect the suture line from stress during the early period of healing especially should cough be prevented. Recurrences, even from direct inguinal hernia should be very rare. All inguinal hernias that may safely be reduced are curable by operation.

## THE INJECTION TREATMENT OF VARICOSE VEINS BY THE USE OF SCLEROSING SOLUTIONS

By H O MCPHEETERS M D, F A C S MINNEAPOLIS MINNESOTA

THE treatment of varicosities of the leg with their various and oftentimes disabling results has been an ever present source of worry to men of the medical profession. Many patients are made invalids for the remainder of their lives and during all that time are in constant distress and discomfort.

Oftentimes patients with large varicosities have little or no discomfort and then again, patients with veins of the same size and location suffer a great deal of pain. The best explanation regarding the cause of the pain is the increased tension on some of the terminal nerve filaments as they penetrate to the skin. Patients often complain of rheumatic pains in the knee and ankle or through the lower leg, when in reality these are all due to the extensive varicosities present, even though they may not be obvious on first inspection.

### ANATOMY

The accompanying charts from Spalteholz show how profusely the branches of the venous system in the lower leg intercommunicate, there being arches in all directions and these in turn communicating with a deeper system of veins. The long saphenous with its collaterals is the one usually involved. Most often the varicosity begins just internal to and below the knee, next about the middle of the lower leg internal, then about the ankle. The short saphenous forms over the upper part of the calf and extends upward joining the deep system just above the popliteal space. Here we often find the largest varicosities of all. There is very often a large varix over the patella and another above this on the inner side of the leg as a branch of the long saphenous. There is a varix of the superficial group of the upper inner part of the thigh below Poupert's ligament extending about the vulva which drains into the femoral vein through the oval window in the fascia lata 2 inches below Poupert's ligament. In some cases this causes much pain.

### ETIOLOGY

The etiology of varicosities is practically always explainable on an obstructive basis, and this obstruction is brought about in several ways. 1 By pressure due to tight bands, most commonly about the knee.

2 By obstruction developing at the oval window in the fascia lata of the thigh where the superior edge seems to cause an obstructing band above, and the inferior cornu resting under the superficial saphenous causes pressure below as this vein dips deep to join the femoral vein. Dr Philip Turner, of London, in a paper in 1923 emphasizes the frequency of this condition as one cause of the obstruction.

3 By obstructions above Poupert's ligament which would mechanically cause a retardation of the return venous flow, due to (a) pregnancy—varicosities very frequently develop during the early months of pregnancy and increase as gestation goes on, (b) constipation, (c) tumors of the pelvis causing obstruction on either or both iliac veins and (d) occupations requiring that the patients be on their feet long hours at a time.

### PATHOLOGY

For a discussion of pathology of varicose veins I would refer you to any standard textbook. There is a degeneration taking place in the wall of the vein giving varicosities of all types. These types are the simple, cecoid, varicose, and anastomosing. In any of these, a thrombus may form which may become organized, thus occluding the vein and which may be the source of an embolus.

Oftentimes the dilatation becomes so marked and the stagnation in the external saphenous system so advanced that the circulation becomes retrograde with the flow downward in the external system, returning through the deep system of veins. This is very easily and clearly demonstrated by Trendelenburg's experiment.

### TREATMENT

The treatment of varicose veins and ulcers is as varied in type and as numerous as any other subject in medicine. An excellent summary of the operative methods was made by Dr J M Hayes<sup>1</sup> in 1925. The old and established treatment of varicose ulcers has been an attempt at sterilization of the ulcers locally, followed by a supporting band to the whole leg to avoid the associated stagnation. As a method of sterilizing the ulcer and aiding the healing a saturated solution of

<sup>1</sup>Hayes J M J Lancet 1925 January

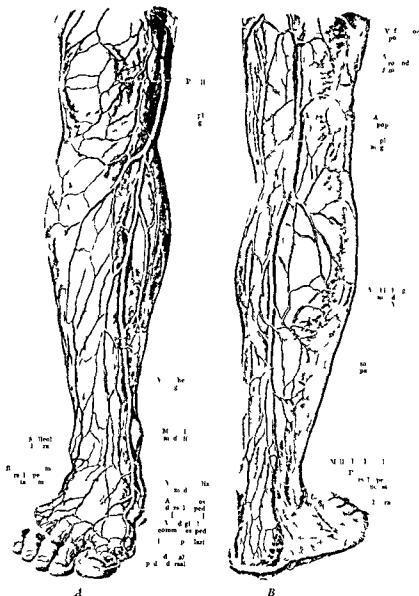


Fig. 1. The anatomy of the superficial saphenous system A and B below the knee and C above the knee (From Spalteholz's *Anatomy*)

picric acid on a wool sponge bandaged in place with pressure and changed every 2 days gives good results. A silver nitrate stick to the edge of the ulcer at the time of treatment facilitates healing. Another treatment is to cleanse the ulcer with benzine and then apply a disc of rubber tissue trimmed somewhat larger than the ulcer and held in place by a zinc glue bandage which is practically the same as Unna's paste from the toes to the knee. This paste should be put on warm, smeared on thick and wrapped with a 4

inch gauze bandage so that the gauze and paste together form a cast or mold to the leg. A rubber sponge is then placed over the ulcer and another bandage applied. This gives pressure directly over the ulcer area. The application is left in place 3 or 4 weeks and then removed. The ulcer is cleansed with benzine and the bandage reapplied. Talcum powder applied to the leg before the paste is used tends to prevent irritation. By the use of Unna's paste compression and support are obtained which prevent the stasis that is

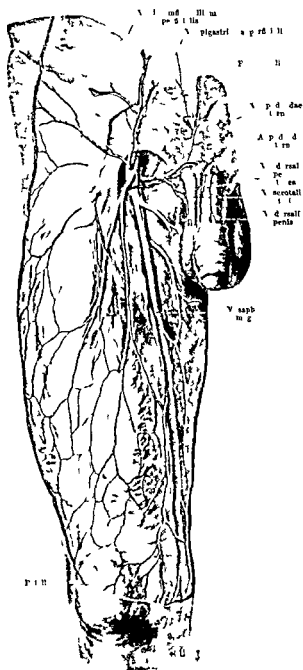


Fig 1, C The anatomy of the superficial saphenous system above the knee

thought to be the active factor in the production of varicose ulcers. In the treatment of varicose ulcers the coarse hydropic granulations seem continually to overgrow the other fine epithelial islands and thus destroy them. The pressure with the rubber sponge just spoken of cares for these granulations better than does any other method. It is advisable to leave another pad with the supporting cast on the leg for at least a month after all healing has taken place.

In any treatment for varicose veins, three things must be considered: first, the removal of

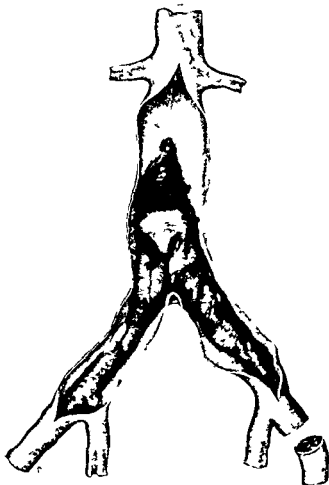


Fig 2 To illustrate the ordinary thrombus formation. Note the intact and normal intima. (From McCallum's Pathology.)

the cause of the trouble, second, the excision or destruction of the veins which are causing the trouble, and, third, the preservation of the deep saphenous vein which is the main channel for drainage of the lower extremity.

The importance of the ambulatory treatment in the care of varicose veins and ulcers cannot be overemphasized; it is the one great advantage of the injection treatment over the operative method.

There are serious objections to operation:

1. There is no more assurance that the varicosities will not recur after the operative method than after the injection treatment if the latter is done just as thoroughly.

2. The danger of embolism is ever present. It may occur in the hands of the most competent surgeon. A check of the records of three hospitals of this city shows that during the year of 1926, in a series of approximately 7,000 operations, there occurred 16 deaths from postoperative embolism, a percentage of one death from embolism per 300 operations performed.



Fig. 3 Mr. C. H. before the injection  
 Fig. 4 Mr. C. H. after 3 injections  
 Fig. 5 Mrs. J. F. H. before the injection  
 Fig. 6 Mrs. J. F. H. after 6 injections  
 Fig. 7 Mrs. J. B. before the injection

Fig. 8 Mr. I. B. after 5 injections  
 Fig. 9 Mrs. C. A. before the injection  
 Fig. 10 Mr. C. A. after 8 injections  
 Fig. 11 Mrs. N. I. before the injection  
 Fig. 12 Mr. N. I. after 15 injections

3 Under the operative method the patient must be confined to bed. Immediately upon getting up the feet begin to swell and this swelling persists at times from 4 to 6 weeks.

4 The scars of the operation are sometimes unsightly and may be more disfiguring and annoying than the varicosities.

5 The anæsthetic, the pain and discomfort of the dressings and the removal of the clips or sutures cause a much greater annoyance to the patient than the slight cramp like pains of the injection method.

The greatest objection to the injection treatment is the theoretical possibility of embolism secondary to the thrombus which may form. Dr. E. T. Bell, professor of pathology at the University of Minnesota, with reference to this possibility of embolism, says: "Regardless of how much experimental work might be done, it would be impossible to rule out the ever present *theoretical* possibility of the danger of embolism with fatal termination, but in view of the fact of the large number of cases injected both at home and abroad, I feel that the *practical clinical* evidence of thousands of injections having been made, with but one fatality from embolism would be more than sufficient to outweigh the ever present theoretical danger."

Solutions used in the injection treatment.

1 *Twenty per cent solution of common salt.* Many of the leading men have now discarded the other solutions in favor of this harmless and non-toxic agent. Linser, who has been the pioneer in this work, hailed the use of salt as a real advance over the other solutions formerly used by him. The salt solution can be used without fear of

toxic effect and in amounts of 3 cubic centimeters to 10 cubic centimeters to the injection. Thus it is of much greater value in the large veins with many branches. The sole objection to its use is the cramp like pain which it stimulates through the extremity below the site of the injection. This pain usually lasts about 1 minute and then is gone entirely. Many patients insist that this cramp-like pain is no more than they have daily when on their feet.

The use of novocain has been suggested several times in the literature but as far as I know it has never been used in this connection. I have used a 1 per cent, 2 per cent and 3 per cent novocain in 20 per cent salt solution, but without benefit. The patients who had no toxic effect or symptoms of collapse with the previous injections now developed a true novocain shock which seemed to be more severe as the stronger novocain solution was used. This was used in three cases before I realized the significance of the reaction and stopped its use. The last patient developed a novocain shock lasting a day and a half from which she nearly died. When one stops to consider the experiments and clinical work of men like Dr. R. E. Farr and how he always insists that one must *never* inject the novocain solution even in  $\frac{1}{2}$  of 1 per cent strength until he has aspirated and knows that the needle point is *not* in the vein, it is clear that it should not be used in this connection.

The salt solution should never be injected except when one is *sure* that the needle point is *within* the lumen of the vein. Repeated aspirations should be made during the process of injection to determine this. If there is any doubt

stop at once, as the injection of this fluid into the perivascular tissue will cause a sloughing. This, however, is a break in technique and not an objection to the method or solution used.

2 *Mercuric chloride 1 per cent* The difference between the effective dose and the fatal dose is so small that it should not be used. It has been discarded by many of the men who have worked in this particular field. The sloughing which follows a poor injection with careless technique is more intense and heals more slowly than with the other methods.

3 *Glucose 50 per cent* This solution is so thick that it cannot be used with 26 gauge needle and the larger needle leaves such a large opening in the vein that there is definitely more chance of the solution oozing out following the withdrawal of the needle. The solution, however, is not toxic and is the method used by several European clinicians.

4 *Sodium salicylate 20 per cent, 50 per cent and 40 per cent* This solution has been used as much if not more than any of the other solutions previous to the last year. Siccard and Parau of Paris have done the most work with this preparation. However, some patients have a definite idiosyncrasy to it somewhat similar to that to quinine. They test their patients first with small doses. In any case, the maximum total dosage is 3 grams. The sloughing which follows a poor injection is the same as that which follows the use of the other solutions. The cramp like pain in the extremity is the same as that following the salt. As to efficiency it is as good as any.

5 *Mercuric chloride 1 per cent and ammonium chloride 1 per cent* This solution is open to the same objections and criticisms as were given for the mercuric chloride.

6 *Calceose* This is an invert sugar preparation which at present is being used very extensively in Vienna. It is thin and causes no pain and has given good results. It should be given further use.

7 *Alcohol* No logical argument can be offered in favor of this solution in the light of our experience with other less toxic, less dangerous, and yet more efficient solutions.

8 In addition to these there are used *Pregel's solution* which is an iodine preparation, *pyck tannin* and several others.

#### TECHNIQUE

1 Examine the patient carefully, using the Trendelenburg test. This is a great measure to determine whether or not the deep system of veins might be occluded and, if it is, then the destruc-

tion or removal of the superficial system would naturally be interdicted.

2 Select the site of injection. This should always be at the upper edge of the varicosity.

3 Sterilize the skin with alcohol.

4 Mark the dilated sacculi or varicosities to be injected with mercurochrome.

5 Place the tourniquet in position but do not tighten it.

6 The type of syringe is one of the most important points in the success of the operation. One, such as the Luer lock syringe in the 5 cubic centimeter and 10 cubic centimeter size, with the rings for the fingers and thumb, is by far the best. There are many such syringes on the market. These give one more absolute control of the needle point and, at the same time, both the injection of the fluid and the aspiration of the blood are more easily performed. With the ordinary Luer syringe, it is easy to withdraw the needle from the vein or force it through the tortuous loop, if it happens to be a small vein, as you shift your hands when trying to aspirate and then inject. Determine whether or not the needle point is in the vein and thus avoid the solution being deposited in the tissue.

7 Use a No. 26 gauge needle. The larger size needle will leave such a large hole in the wall of the vein that the fluid may ooze out, particularly if it is under pressure. The bevel on the large needle is so long and the wall of the vein so thin that with the small veins the needle point may be sufficiently in the lumen of the vein to aspirate the blood and yet as one injects, the solution may go into the perivascular tissues. Since the saline does not cause coagulation of the blood, there is no danger of the needle becoming occluded even with this fine lumen.

8 Be sure the needle point is well in the lumen of the vein. If not, do not inject. Withdraw and let this particular vein go until a future time.

9 Do not inject the vein under too much pressure, as this may cause two things: (a) an oozing backward following the withdrawal of the needle, and (b) if the vein is very thin walled, with perhaps all the muscle layers ruptured in one spot, the vein may actually rupture here with an effusion of the blood and solution into the perivascular tissue. Control this pressure by elevation of the leg and the use of the tourniquet.

10 Leave the needle in one minute following injection, and try to localize the fluid as much as possible by the tourniquet and elevation.

11 Immediately following the withdrawal of the needle put a small gauze pad for pressure directly over the needle puncture and follow this

by a bandage tightly bound. A 4 inch woven cotton elastic bandage similar to the ace bandage is by far the most efficient for this purpose. The bandage is left on for days it is then removed and rebanded for 2 days longer. The pressure pads of gauze will have caused a collapse of the vein at the site of injection and often the walls will have so adhered by this time that the vein will not refill. This is an important point in the technique and one not sufficiently stressed in the literature. The patient always feels more comfortable for several days following the injection if the bandage is continually reapplied.

12. The number of injections must be decided entirely by the case in hand—usually one for small veins and three to five for the larger ones. At one sitting I have often made three to six separate injections depending upon the total amount of material used and how much the patient minds the distress of the injection. I have used as much as 60 cubic centimeters of a 0 per cent salt solution in 5 cubic centimeter to 10 cubic centimeter injections with no untoward results. This patient however developed a sense of thirst warmth and slight faintness which passed off in about 10 minutes.

#### RESULTS

##### 1. Immediate at the time of injection

a. The patient develops cramp like pains through the leg distal to the site of injection. It times even into the foot. This pain seems to bear no relation to the caliber of the vein injected or to the extensiveness of the varix. It is best explained on a basis of the strong salt solution penetrating the vein walls and directly stimulating the muscle fibers of the leg thus causing a cramp similar to the experiment of saturated salt solution on the frog's muscle. Others have explained it on the vasomotor basis of intermittent claudication. This does not seem reasonable because the patient does not have the same vascular disturbance in the toes and foot as in the former condition.

b. At times there will be a sudden collapse of the vein distal to the site of injection as the fluid enters. This collapse may extend 3 to 8 inches downward. It usually occurs in the veins about the size of a lead pencil and is caused by the direct stimulation of the contractile fibers in the vessel walls. When followed by the pressure pad and bandage the collapsed vein may never fill again though usually it does.

2. Remote or later results. When the patient returns on the second day the vein is often hard and tender. It may be hard and cord like to the size of one fourth to half inch in diameter and at

times throughout a distance of 3 to 8 inches. If the intima has been destroyed and the pressure pad has been sufficient to hold the vein collapsed there will be no hard thrombus but on the contrary the former varicosity can scarcely be located. This means that the walls of the vein under the effect of the pressure following the injury to the intima have actually agglutinated and sealed together. There are three reports in the literature on the histopathology occurring in the vein after the injection. The most complete work was by R. Bazels in his Paris thesis in 1924. These results are duplicated and confirmed by G. I. Regard a surgeon and privat docent of the University of Geneva Switzerland. The latter's work and opinion have been accepted as positive and of real value. V. Meisen, M. D. surgeon in chief of the Copenhagen Polyclinic in an address delivered before the Medical Society of Copenhagen October 20, 1925 gives a most thorough discussion of the whole subject and his reports of the histopathology are identical with those of the two authors cited above. These reports prove conclusively that the pathology developing in the vein after the injection is exactly what would be expected. The intima is destroyed and the vein becomes entirely obliterated through the agglutination of the walls in one case and in the other the organization of the chemically produced thrombosis with the vein walls. Ultimately, this leaves a mere fibrous cord. Regard concluded his report with this remark. The danger of embolism is to be feared no more than in ordinary surgery or in the accidents of daily life.

3. The untoward results. (a) The painful cramps have been previously discussed. (b) A burning or smarting in the tissues will occur if the fluid is outside the vein. This burning is positive assurance that some of the fluid is in the perivascular tissue and will cause a subsequent slough which is painful sore and tender but which progresses with very little discharge and leaves a clean base that heals fairly readily. The separation however, is slow.

4. Recurrence. Some of the larger veins may take three or four injections before they are obliterated the vein getting thicker walled and more leathery all the time.

5. Fatal results. A search of the literature on the subject shows but two deaths following the injection of varicose veins by the use of sclerosing solutions. One of these was reported by Hohlbaum.<sup>1</sup> Hammar<sup>2</sup> reports another case. Lano<sup>3</sup>

<sup>1</sup>H. Hohlbaum Zentralbl. f. Ch. 1922 XI 315  
<sup>2</sup>H. Hammar Deutsch. med. W. hnschr. 1919 XI 4

in his last article in 1925, says that he has used it in thousands of cases with no fatal results in any form and that he has never heard of any other than the two cases mentioned above. In Hohlbaum's case the final decision was that the death was due to a fat embolus and not from the thrombosis direct. In Hammar's case the patient died from mercurial poisoning. The onset of the symptoms began a few hours after the treatment, the patient dying on the twelfth day.

### CONCLUSIONS

This report is based upon the clinical results in a total of 31 cases having received approximately 180 separate injections.

1 The results are conclusive evidence that the injection treatment of varicosities with 20 per cent sodium chloride solution is superior to other methods, operative or otherwise.

2 The danger of death from embolism, though *theoretically* ever present, *practically* and *clinically* is almost nil.

3 The treatment is ambulatory, permitting patients to continue their usual routine of work.

4 The patients are spared a great expense as all hospital bills are avoided, they are not compelled to leave their work for 4 to 6 weeks (which often means losing their positions).

5 If good technique is used all sloughing can be avoided.

6 The cramp-like pains through the leg, distal to the site of injection, are no more severe than many patients have daily.

7 It is a simple matter to repeat the treatment if the varicosities recur.

8 Unless the blood is repeatedly aspirated back into the syringe, *do not inject*. When in doubt *don't*.

9 The results are so uniformly satisfactory and so easily accomplished and so little risk to life is entailed, that I believe surgery for the treatment of varicose veins, other than in a few selected cases, will soon be a thing of the past.

I wish to acknowledge my indebtedness to Dr I. J. Souba for his courtesy in extending to me the privilege of his research connection and also to Dr Daniel H. Bessesen for his translation of German articles.

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## FOREIGN BODIES IN THE BRONCHUS OF INTRAPULMONARY ORIGIN

REPORT OF A CASE<sup>1</sup>

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**C**ALCIFICATION in the lung pleura and mediastinal lymph nodes can be often demonstrated roentgenologically in apparently healthy persons. It is an almost constant finding on postmortem examinations of adults and is usually attributed to the healing of a tuberculous lesion. In most cases this is a beneficial process but in rare instances one or more of the calcified hilar lymph nodes ulcerates into the bronchus. In such a case the calcified mass may give rise to all of the symptoms produced by any foreign body aspirated through the mouth.

Many writers have emphasized the necessity for suspecting a foreign body of extrinsic origin in the bronchus in all cases of pulmonary suppuration but that a foreign body may arise within the chest and cause equally disastrous results has not been emphasized. A number of cases of stones in the lung have been reported in which the diagnosis was made after the patient had coughed out one or many calcareous masses (1, 2, 3). In a previous paper (4) a case was reported in which a patient was relieved of chronic pulmonary suppuration by the removal bronchoscopically of a large amount of calcified material from the lumen of a bronchus. The calcification apparently had followed the aspiration of a tooth pick. The case reported herewith shows the difficulty of diagnosing the condition and how a fatal outcome may result from the prolonged sojourn of the foreign body.

A man aged 53 was examined in the Mayo Clinic January 4, 1927. In 1918 he had had influenza followed by moderate cough and expectoration but with little impairment of general health. In August 1916 following exposure to the cold and expectoration increased and was accompanied by fever and general debility. The sputum was purulent with a foul odor. Three weeks before his examination a severe pulmonary hemorrhage had occurred. There was no history of the aspiration of a foreign body.

The patient was weak and was admitted to the hospital on his arrival at the Clinic. The temperature varied from 100 to 101 degrees and was of a septic type. Examination of the sputum revealed pyridia and fusiform bacilli only. There was marked limitation of movement on the left side with many moderately coarse rales throughout the lower lobe of the left lung. A roentgenogram revealed what appeared to be an abscess corresponding with the patho-

logical area found on physical examination. On January 11 a bronchosopic examination showed a stricture in a bronchus in the lower lobe of the left lung. This was dilated and a large amount of foul pus was aspirated.

Following evacuation of the secretion the patient's general condition improved markedly and within 4 days the temperature was normal. After 7 days of normal temperature and general improvement pain developed suddenly on the left side of the chest and the temperature rose to 100 degrees. The symptoms were attributed by the patient to the fact that he had lain on his left side during the previous night. He was unable to bring up any pulmonary secretion and it was thought that a sudden obstruction in the bronchus had occurred. A second bronchoscopic examination was made although the patient was desperately ill. At this time there was little pus in the bronchus but three small pieces of calcareous material were removed from the bronchus below the stricture (Fig. 1). It was then decided that empyema had occurred and thoracentesis revealed a small amount of pus at one point of puncture, clear fluid at another and old blood at a third. This led to the conclusion that the empyema was multilocular and further operation was deemed inadvisable. Death occurred shortly.

Necropsy disclosed empyema with multiple sacculations, chronic tuberculous infection of the left lung and hilar lymph nodes marked calcification of the lymph node and their apparent erosion through the bronchial wall. At the division of the left main bronchus was an area of scar tissue that evidently marked the prolonged sojourn of a foreign body. In the bronchus below the point of stricture were two large calcareous deposits lying free in the bronchial lumen (Fig. 2). Evidence of terminal pneumonia in the lower lobe of the right lung was also found.

If the empyema had not resulted fatally it is likely that with repeated dilations of the bronchial stricture the foreign bodies could have been removed through the bronchoscope with restoration of the patient to normal health.



Fig. 1. Calcified material removed at the time of second bronchoscopic examination.

Fig. 2. Large calcareous masses found in bronchus at the postmortem examination.

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## SOME MINOR MODIFICATIONS OF HARVEY CUSHING'S SILVER CLIP OUTFIT

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FOR some years Cushing has been using small silver clips in place of ligatures to control bleeding when operating on the brain. Many surgeons doing neurological surgery have adopted these clips, and feel that they form a very important adjunct to their technical equipment. Despite a good deal of personal attention the writer has had considerable difficulty with an outfit similar to the one used by Cushing. For the past 6 months a modified outfit has been used with satisfaction in this clinic and a description of it may be of general interest.

A simple instrument has been devised which cuts the wire and at the same time punches out a clip (Fig. 1, B). No wire is wasted and a few feet will make a great number of clips. These clips are all uniform and can be quickly made

without experience. The alternative method of making the clips by winding wire tightly on a diamond shaped bar and then cutting along the sides with a special pair of scissors, was unsatisfactory, the sides of the clips were often of uneven length and the ends rough, and despite a great deal of care we have frequently had difficulty in using them efficiently.

A flattened wire has been more satisfactory than the round wire, as it overcomes the tendency of the clip to turn in the clip holder, and prevents the sides of the clip slipping past each other.

The magazine (Fig. 1, C) has been mounted on a heavy base, in such a manner that the covering can be gradually pulled out as the clips are

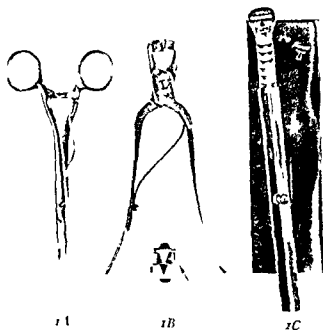


Fig. 1. 1. A. Clip holder. B. Instrument for cutting wire and at same time punching out clip. C. Magazine for storing clips. The arrow points to the wire.

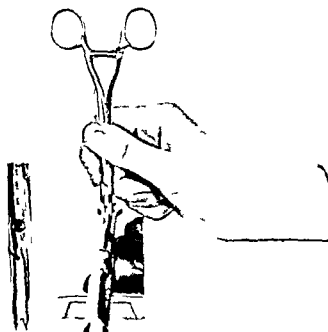


Fig. 2. Method of using clip holder. It is possible for the operator to slide the holder down on top of a clip with one hand.

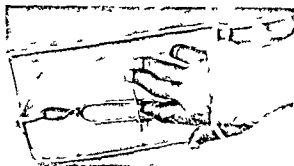


Fig. 1 Modified Walker splint with authors' finger calipers applied. Note traction by means of rubber band.

applied elsewhere. In fact we are convinced that it is the only method which will give the desired anatomical and functional result in those cases of very severe lacerations and contusions of the soft parts accompanied with one or more phalangeal fractures.

Fracture of the distal phalangeal bones because of certain anatomical features presents a clinical picture and a set of indications for treatment which are totally different from those of fractures of the other segments of the fingers.

#### FRACTURES OF THE TIPS

The distinctive features of the pathology of fractures of the tips of the fingers, the possible gravity and the often prolonged course of these injuries have only been appreciated since Kanavel (4) demonstrated that the pulp of the theca of the finger tip lies in a closed trabeculated connective tissue sac. This sac is least dense at the lateral borders of the ungual tuberosity of the phalangeal bone. This explains why the hemorrhage which collects in the closed space after a fracture of the phalangeal bone so often escapes dorsally around the margins of the ungual tuberosity and forms a subungual hematoma.

Proximally this sac is limited by its attachment in the region of the insertion of the flexor pro-

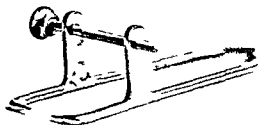


Fig. 3 Authors' metal finger caliper which can be applied to any phalanx or to the distal end of a metacarpal (Mock and Ellis).



Fig. 4 Method of applying extension through the finger nail.

fundus tendon. Distally it is attached to the margin of the broad irregular terminal expansion of the bone. The periosteum of the ungual tuberosity is so intimately connected with the bone surface that it is invariably torn when the bone is fractured so that subperiosteal hemorrhage after fracture never occurs. The blood vessels to the diaphysis of this terminal phalangeal bone run parallel to its border on either side and within the closed fascial space and the nutrient foramina are on the flexor surface of the bone within this space.

**Pathology.** The hemorrhage and edema incident to fracture of the diaphysis if it does not escape to the dorsum of the finger tip as above described increases the pressure within the closed fascial space producing a tension capable of shutting off the blood supply to the diaphysis. Necrosis of the diaphysis may and often does result and this mechanism explains the frequent



Fig. 4 Banjo and Walker splints with finger calipers. The points are held in position in the cortex of the phalanx by means of a set screw.

necrosis of the entire diaphysis often seen developing several weeks after a simple chipping fracture here

Moorehead (8) has described this mechanism plus supervening low grade hematogenous infection of the accumulated blood and necrotic bone in this crowded space, as the pathogenetic factors of so-called "bone felon" which every surgeon has seen develop several weeks after closed fractures in the finger tips. Since this mechanism to produce tension and necrosis is not effective where laceration into the closed sac occurs, necrosis of the terminal phalangeal bone, osteomyelitis, and "bone felon" are much more frequent in closed fractures of the tip than those which are compound.

Madden (6) has called attention to this fact in his study of chip fractures of the finger tip, and every one with any experience in the surgery of trauma can verify this observation from his own experience.

**Clinical course.** In Hurley's (2) series of 27 cases of chip fracture of the tip occurring in steel mill employees, 1 lost 196 days from work, 17 lost approximately 60 days each, 9 not more than 3 days each. These figures indicate the economic importance of careful examination and prompt recognition of the surgical indications in the treatment of these conditions.

**Treatment.** On the first presentation of a crushed finger tip to the attention of the surgeon, an X ray examination is imperative. Examination for crepitus is useless because the fragments are practically always separated. We found a separation of 1 millimeter or more in every case on checking up the X rays of 30 consecutive tip fractures coming to our attention. In about 9 out of 10 of these cases in which a fracture is found, conservative treatment by immobilization is all that is necessary. In the remaining one, however, the following signs and symptoms develop within a few hours and become progressively worse: (1) swelling of the tip, (2) tenderness, and (3) throbbing pain.

Often the patient is unable to sleep the first night after the accident because of the throbbing pain. As has been pointed out, these symptoms do not occur in compound fractures or in those closed fractures accompanied by extensive laceration of the theca. This clinical picture presents an indication for immediate operation. This increasing tension in the finger must be immediately relieved. The site of the incision depends upon the location of the hemorrhage.

If the hemorrhage is subungual, a careful examination should be made to ascertain whether

it is confined beneath the nail or has extended up under the eponychium. In the former case a chip is cut from the center of the fingernail with a straight knife, the edge of the blade being held almost parallel to the surface of the nail, and the knife drawn toward the tip of the nail. By this maneuver very little pressure need be exerted upon the very tender nail. This seems to us preferable to boring the nail, which is quite painful and provides for the escape of the blood only a tiny hole which is easily closed by coagulation or bits of fibrin and may have to be opened subsequently. The approach to the nail bed by incision beneath the free edge of the nail is objectionable both because of the extreme sensitiveness of this region, and because it cannot be thoroughly sterilized, the epidermis being often fissured and irregular where it is attached to the nail. If the hemorrhage is principally beneath the lunula or proximal to this under the perionychium, it can be liberated by separating this structure from the eponychium with a sharp knife.

If the hemorrhage does not appear under the nail, an "alligator mouth" incision should be made through the theca by a careful dissection with a Graefe cataract knife  $\frac{3}{8}$  of an inch below the nail through the tip and including the full width of the finger backward until the site of the injury is exposed.

Although, as Jones (3) points out, the hyponychium is peculiarly resistant to infection, yet the rough and thickened skin of the fingers of working men presents a contaminated field. Careful surgical preparation of the finger before operation is essential. One may use full strength tincture of iodine followed by alcohol. Excessive grease and oily dirt can be removed with ether or, as we prefer, any commercial carbon tetrachloride, "cleaning fluid." No anæsthetic is required for the incisions about the nail. Because we have felt that the swelling of the finger often resulting from the injection of a local anæsthetic might contribute to a passive congestion, which we were trying to relieve, we have routinely employed gas and more recently ethylene in inducing general anæsthesia for incisions of fingers.

Another type of chip fracture in which operation is indicated is the one which, although presenting no unusual symptoms at first and no sign of increasing tension, remains tender. Roentgenograms must be made at frequent intervals. If the tenderness persists after 2 or 3 weeks, it will be found in the roentgenograms that the fragments are becoming smaller and show signs of necrosis instead of bone proliferation. It is

evident that the blood supply to the fragment from its periosteum is not sufficient for bone proliferation to occur. The removal of such fragments through a small incision in the tip is indicated. No curettement should be done as it is important not to injure any normal periosteum of the diaphysis which may remain. We have a large number of cases which show regeneration of the entire distal phalanx from shreds of periosteum left behind after the diseased bone had been removed.

#### FRACTURES OF THE SHAFTS OF THE PHALANGES AND METACARPALS

Fractures of the shafts of the phalanges and metacarpals present all the varieties and complications found in fractures of the long bones. Treatment depends upon (1) displacement and comminution (2) joint involvement or complicating dislocations (3) concomitant injuries of the soft parts.

Simple transverse fractures and others without displacement or joint involvement need only immobilization on a palmar or dorsal splint for 2 or 3 weeks with daily manipulation and passive motion of nearby joints, the progress of callus formation being checked occasionally by roentgenograms. In the metacarpus such simple fractures are similarly treated with the fingers immobilized in flexion around a bandage roll or padded wooden ball.

When displacement, comminution or joint involvement exists extension is necessary, the choice of method depending on the condition of the adjacent soft parts. A banyo splint with either plaster wrist band or aluminum forearm splint or a Walker splint (Fig. 1) to which a wire frame has been attached is applied and from this extension is made upon the finger with rubber bands or a small coil spring which can be attached to the finger by moleskin adhesive strips or Wheelers (13) or Sinclairs (10) glue or gauze strips.

Vallet (12) has devised an extension apparatus for transverse fractures of the phalanges with angulation which comprises a flat aluminum splint like a tongue blade which can be angulated in the region of the fracture to secure correction of the deformity and a sliding metal piece with hooks fitting over the webs between the fingers against which counter traction is made. This like the wire splint described by Wilson and Cochrane (14) is suitable for simple fractures of the middle and proximal phalanges of the second and third fingers which have a web on either side of the base.

We have, for most purposes, discarded the use of adhesive and glue, and employ finger nail extension which obviates the slipping of adhesive, blistering, or desquamation of the skin often resulting from glue. This is applied by boring two holes in the free margin of the finger nail with a sharp pointed knife (Fig. 2). If the free margin of the nail is not long enough, the skin can be pushed back under local anesthesia a procedure which is entirely painless. Through these holes in the nail margin small silk ligatures or malleable wire is introduced and this is attached to the rubber band. Extension can be made in this manner without injury to the nail. Occasionally the nail moves forward about  $\frac{3}{8}$  inch so that the lunula increases in depth, but after extension is removed the normal contour of the nail is reestablished. Such extension on the nail, because of the intimate connection between the hyponychium and periosteum of the distal phalanx practically constitutes direct skeletal traction and considerable force can be applied. We have used as much as 8 ounces of traction. This nail extension also allows the application of Dakin's solution to open wounds and can be used also in cases of swelling and contusion of the finger where adhesive or glue would not adhere or is contra indicated. This type of extension however is not forcible enough to overcome any considerable over riding or to prevent shortening in case of marked comminution such as those seen in severe crush injuries of phalanges and metacarpals and where more powerful extension is indicated or where considerable torsion is necessary to coapt spiral fractures. In these either the Steinmann nail or the finger calipers must be applied.

To Schum (9) belongs credit for the first use of the Steinmann nail in fractures of the hand. In his capacity as director of surgery for the police of the City of Berlin Schum has had a wide experience with severe hand injuries, including many compound and shattered fractures of the metacarpals. He reports 50 cases in which a Steinmann nail was applied but does not describe his technique. He applies extension to the nail by the use of a banyo splint with cross bars which are useful in case torsion is necessary to bring the fragments in alignment. He rarely leaves this extension on longer than 2 or 3 weeks as sufficiently firm union has taken place by that time.

#### FINGER CALIPER

For the same type of injury for which the Steinmann nail is employed, we are now using a special type of caliper which we have devised

This consists of a U shaped bar approximately 5 inches long,  $1\frac{1}{2}$  inches wide and  $\frac{1}{8}$  inch in diameter, hinged at the apex, with the free ends tapered and turned in at right angles toward each other. The points are held in position in the cortex of the phalanx by means of a set screw passing through two flat strips arising from the sides of the splint (Figs 3 and 4). The technique for the application of these is very similar to that of the Steinmann nail. In our experience the Steinmann nail produces more tissue reaction and involves more danger of fracture of the phalanx in its application than do these calipers. In this connection there are several anatomical considerations of importance. The shafts of the phalanges are, of course, not round but flattened, especially the proximal one on the sides of which flanges are developed for the attachment of the lumbrical and the interosseous muscles. In muscular subjects, these phalanges are quite flat. It is not necessary or even advisable to apply the nail or caliper to the injured phalanx, as by the application of skeletal traction to the phalanx distal to the injured one, full extension of the intervening joint capsule can be maintained and at the same time traction of the fractured fragment secured.

In fractures of the metacarpals, extension is applied to the proximal phalanx, and the best location for its application is the neck of this bone just proximal to the capsular ligament. The bone is free in this region, while the more proximal parts of the lateral surface are covered by the ligaments of the lumbricales and the interosseous muscles. In order to avoid the extensor tendon sheaths which extend further around the phalanx than those of the flexor tendons, incisions are made about  $\frac{1}{8}$  inch volar to the lateral margin of the bone. A small knife is introduced and the extensor tendon sheaths pushed back without being opened. Incision of the skin should be about  $\frac{1}{4}$  inch in length and extend distal to the point where the extension is to be applied so that there will be no tension on the skin by the point of the calipers or the nail which should be situated at the proximal end of the incision. The periosteum is pushed back with the end of the knife. These incisions can be made under local anesthesia. The points of the caliper are screwed firmly into the bone, or if a nail is used, a  $\frac{3}{32}$  inch drill is passed through the neck of the bone and an ordinary Glover's needle, such as is used in suturing the skin, is inserted and broken off so as to extend  $\frac{1}{4}$  inch beyond the skin on either side. The needle is secured in position by a silk suture passed

through the eye and tied around the finger. Narrow strips of gauze soaked in compound tincture of benzoin are used to seal the wounds and wrapped around the needle or the caliper where this passes through the skin incision.

Some particular types of fracture require special types of treatment. In drop finger, or mallet finger, the insertion of the extensor is torn off by the avulsion of a small flake of bone at the insertion of this tendon into the dorsum of the base of the distal phalanx. This is generally sustained by violence applied to the tip of the partially flexed digit. It is imperative that the distal phalanx be brought into perfect apposition with the avulsed fragment. This can generally be accomplished by splinting the finger with the distal interphalangeal joint in sharp hyperextension, as described by Bainbridge (1) and Laird (5). If the X rays do not reveal perfect apposition, open operation or subcutaneous operation with the insertion of needles as described by Tennant (11) must be performed. The finger should be left immobilized for 3 weeks, after which careful passive motion is instituted.

Bennet's fracture of the base of the first metacarpal is usually produced by force transmitted through the bones of the thumb. The fracture line is oblique and the fragment may consist of either the dorsal or volar portion of the base. This fragment cannot be controlled and after manipulation reduction tends to slip out again. We find that powerful traction on the thumb, generally applied by means of calipers, accompanied by either flexion or extension depending on the position of the proximal fragment, will accomplish and maintain reduction.

Non union of fractures of the long bones of the hand are fortunately uncommon. The introduction of foreign bodies into the hand in these cases is seldom, if ever, advisable. We have secured very satisfactory results by applying strips of periosteum around the ununited ends after freshening them.

Fractures resulting from bullet wounds are often accompanied by considerable comminution and require caliper traction after debridement has been done and the Carrel method of wound sterilization instituted.

#### CONCLUSIONS

- 1 Traction without injurious manipulation and splinting will often reduce and maintain reduction in fractures of the long bones of the hand.

- 2 Direct skeletal traction is applicable to these fractures and is the indicated method in cases in which other traction cannot be applied.

3 Skeletal traction especially by the finger calipers designed by the authors, has given the best functional end results in cases of severe trauma of the soft tissues concomitant with phalangeal fractures

4 Due to the proximity of joints in all finger fractures constant attention must be given to the preservation of joint function

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AN OPERATION FOR STERILITY IN THE MALE<sup>1</sup>

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**B**ILATERAL epididymitis is the most frequent cause of obstructive sterility in the male. Strictures of the vasa deferentia and ejaculatory ducts are also etiological factors. Various procedures have been recommended and employed for restoring the continuity of the seminal duct. Practically all consist in short-circuiting the vas deferens for a block at the tail of the epididymis and resection and reunion of the strictured vas.

Successful end results have, however, been so few that the patient can entertain very little hope for a renewed fertility. The Martin operation of vaso-epididymostomy (15) and its various modifications—a procedure most frequently employed—with few exceptions (Hagner, 11), has given no more than 10 per cent successful results.

Because of the large number of failures, some men have abandoned all attempts toward restoring the continuity of the duct and recommend puncture of the testicle or epididymis and aspiration, and artificial impregnation (Posner, 21). Lespinasse's artificial spermatocele sac (12) was for the purpose of accumulating a large quantity of semen to be deposited in the same manner.

*Strictures of the ejaculatory ducts.* Permanent occlusion of the ejaculatory duct is rare. Temporary blocking due to plugs of mucus or pus, or edema and distortion of the verumontanum is quite common. When stricture is found, dilatation through the endoscope (5) may be possible. Most attempts at dilatation are unsuccessful.

*Strictures of the pelvic portion of the vas deferens.* These are, fortunately, quite rare, having been found in about 1 per cent of vasotomies (Belfield, 2). Repair of these strictures is practically impossible because of their inaccessible location. Boari (3) united the vas to the anterior urethra and recommended this method for the relief of strictures of the pelvic vas and the ejaculatory ducts.

*Strictures of the scrotal portion of the vas deferens.* These include all strictures of the vas up to the external inguinal ring and for a few inches beyond, for the redundancy of the vas deferens allows it to be pulled out for some distance. Strictures of this portion of the vas deferens are quite common.

They are frequently present in association with an epididymitis and must be removed before any

attempt is made at short circuit of the vas. They are also frequently found without an epididymitis—these are usually unilateral—and may be analogous to strictures of the lower portion of the ureter. They may also be due to trauma or injection of strong irritants in vasotomy.

This is an accessible portion of the vas deferens and strictures in this region can be readily and successfully repaired in the majority of cases. Resection of the strictured portion and end-to-end anastomosis, with a silk worm suture in the lumen coming out through the skin to act as a splint and to direct epithelization, has proved successful in many cases. Successful results with this and other procedures, both clinical and experimental, in restoring the patency of the vas have been reported by Mayo (16), Lydston (14), Christian and Sanderson (5), Pignatti (20), Wheeler (27), Schmerz (25), Seyberth (26), Gohrbandt (7), and others.

Vas epididymostomy, union of the vas deferens to the epididymis above the obstruction, and vaso-orchidostomy, union of the vas to the rete testis, are the procedures employed for the relief of the occluded epididymis.

## VASO EPIDIDYMOSTOMY

Martin's original operation was a lateral anastomosis of the vas to the head of the epididymis with catgut sutures, the operation being entirely extravaginal. Since then, various modifications in the suture material used and in the choice of the point of attachment to the epididymis have been reported by Fuller (6), Hagner (10), Quimby (22), and others.

Silk, human hair, and silver wire for suture, and the placing of the sutures to produce a circular anastomotic channel, are some of the variations from the original. End anastomosis of the vas to the epididymis (Hagner, 8) and union of one vas to the epididymis of the other side (Hagner, 9) have been reported. Bogolyuboff (4) reported a series of experiments in which he resected the tail of the epididymis and implanted or united the cut end of the vas to the epididymis with a few successful results.

The reasons for the relatively few successes in vas epididymostomy may be summarized. Some are well recognized and others not generally considered or understood.

<sup>1</sup>Presented before the Chicago Urological Society, November 23, 1926.



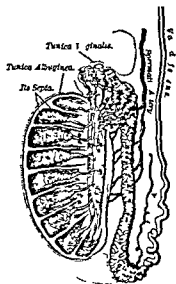


Fig 1. Cut from Gray's Anatomy showing particularly the rete testis and epididymis

1 Vaso-epididymostomy is not a direct anastomosis. A cup-shaped piece of tubule of epididymis is removed in the hope that anastomosis will develop from one of the convolutions. Direct vaso-epididymostomy (Lespinasse 13) is rarely possible because of the almost microscopic size of the tubule of the epididymis above the tail.

2 Slight hemorrhage with a blood clot at the point of anastomosis, trauma of the operation and the irritation by the suture material can produce enough scar tissue to occlude the anastomotic channel. McKenna (17) recommended a procedure which he modified later (18) for the purpose of preventing clots from organizing and closing the point of anastomosis as shown in Figure 2 and reported some success. It consists in the insertion of a silk worm gut as a retention suture through the vas through the point of anastomosis and through the epididymis united on the skin of the scrotum and left in place 5 to 7 or 10 days.

3 The epididymis tubule is very thin and as friable as tissue paper. Any suture material will tear through readily and particularly so as a result of the oedema following the trauma of the operation. Even though the point of anastomosis be in the intravaginal portion of the epididymis union will not be very firm for the tunica vaginalis covering the epididymis is much thinner than that covering the testis (Morriss 19).

4 The testicle moves up and down with the contraction and relaxation of cremasteric and dartos and the vas deferens which is redundant

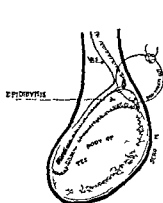


Fig 2

Fig 2. Diagrammatic sketch showing lateral anastomosis of the vas to the head of the epididymis with a silk worm through the point of anastomosis coming out through the vas and epididymis and tied on the skin as described by McKenna. The silk worm is intended to prevent blood clot from organizing and closing the anastomotic channel.

Fig 3. Diagrammatic sketch similar to Figure 2 except that the silk worm is run through the epididymis above the point of anastomosis to prevent movement of the vas and tension at the point of anastomosis (Authors modification).

and also has some elasticity and peristaltic action tightens takes up slack and loosens with the movements of the testicle and with filling and emptying of the bladder. Because of these factors there is always considerable tension at the point of anastomosis with a resulting separation of the apposed tubules. This is probably the most important cause for failure of the operation.

I have recently had a successful result in which an attempt was made to limit the mobility of the testicle and vas, as shown in Figure 3. A silk worm gut was run through the vas and epididymis as in the procedure recommended by McKenna except that the silk worm emerged from the vas above the point of anastomosis then through the epididymis above the point of anastomosis and out through the skin.

5 It may be well to note when a successful result is obtained with any of the procedures mentioned or any of the others to be discussed that the new anastomotic channel may become gradually occluded by contraction of scar tissue about it or within its lumen so that one cannot speak of permanent results.

#### UNION OF VAS DEFERENS TO SPERMATOCELE

Spermatoceles are common and may be present coincidentally with occlusion of the epididymis. Lateral anastomosis or implantation of the cut end of the vas into the sac as shown in Figure

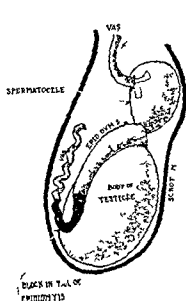


Fig 4

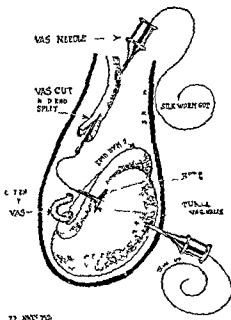


Fig 5

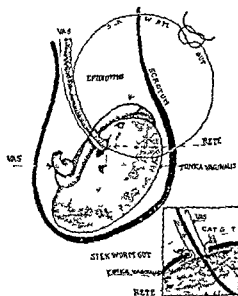


Fig 6

Fig 4 Vas implanted into spermatocele when it is coincidentally present for a block in the epididymis. Diagrammatic representation of an operation that should offer excellent possibilities for success.

Fig 5 Author's operation—union of vas to rete testis with a silk worm through testicle and point of anastomosis. Diagrammatic sketch showing the various steps of the operation as described in the detail of the operation. The needles in the vas and that through the testicle are thread

ed with the silk worm and then removed. Sutures are placed in the split end of the vas and united to the tunica vaginalis at the rete.

Fig 6 Operation completed. Vas is united to rete testis and the silk worm running through vas and testicle is tied on skin of scrotum and left in place 7 to 10 days before removal.

Lower inset shows end of vas spread out and dipped into rete and united with catgut to tunica.

4, offers excellent possibilities for success. Hagner (11) has reported a successful case. Attempts to produce true spermatocele experimentally for the purpose of having a sac to which the vas could be attached have been entirely unsuccessful (23).

#### UNION OF THE VAS DEFERENS TO THE RETE TESTIS

The rete testis is an intercommunicating network of tubules located in the mediastinum of the testicle, whose function is similar to that of the renal pelvis, the sperm accumulating in the rete and passing out into the efferent ducts. The vasa efferentia and the rest of the seminal duct are developed from the wolffian body and wolffian duct, whereas the rete develops from the genital gland (Wilson, 28). In some lower vertebrates living in water and in many invertebrates the duct system does not exist, the sperm is expelled from the rete into the peritoneal cavity, as is the ovum of the human female, and then out through pores in the lower abdomen.

The testicle has a thick tunica vaginalis and also a tunica albuginea and vasculosa, so that sutures inserted through its coverings have an excellent chance of remaining in place. The rete testis, consisting of many tubules should

theoretically at least, offer better opportunities for anastomosis than the single tubule of the epididymis.

Union of the vas to the rete was first done experimentally by Scaduto (24), who resected the epididymis and united the cut end of the vas to the rete. None of his operations were successful. Bogoljuboff (4) reported a few successes and since then various authors, mostly foreign, have reported varying degrees of success and failure with this procedure.

#### AUTHOR'S OPERATION

The operation that will be described consists in the union of the vas to the rete with the addition of a silk worm gut running through the vas and testicle at the point of anastomosis and tied outside on the skin of the scrotum. The purpose of the silk worm gut is to develop a patent channel, to prevent organization of a scar and to make a path for epithelialization. It furthermore fixes the testicle and vas quite well, preventing their mobility and preventing tension at the point of anastomosis.

The chief objection to this procedure is the possible injury to the testicle from the silk worm that is run through it and allowed to remain in

place a number of days. Section of the testicle in all the fourteen operations on dogs in which the suture remained in place for periods varying from 2 to 14 days was done to determine the extent of injury to the testicle.

No evidence of scar was to be found. The point of exit of the silkworm on the convex surface of the testicle could not be located and except for the destruction of a few tubules along the course of the silkworm apparently no injury to the testicular tissue resulted from this procedure.

In none of the 14 operations was an animal infected despite the constant gnawing and sawing away at the retention suture by the dogs. In 8 the silkworm was pulled out prematurely. In another series of experiments in which the cut end of the vas was united to the head of the epididymis with silkworm left in place as in the McKenna operation all the dogs became infected or developed a localized epididymitis from the constant pulling at the suture. It is evident therefore that the testicle withstands considerable trauma and is quite resistant to infection.

Of the 14 bilateral operations on 7 dogs only 6 can be reported for the silkworm was pulled out before the fifth day in the other 8. Of the 6 in which the silkworm remained in place 7 to 14 days 2 were successful. Sperm could be squeezed out from the testicle through the vas in these 2 cases.

This procedure appears to be rational, and with improvement in technique should give an appreciable number of successful results on the human where the uteruses will remain undisturbed. I have recently performed this operation on one man but cannot determine the end result for I have lost track of him. In this case also except for the immediate reaction during the first few days there was no gross evidence of injury to the testicle.

#### DETAIL OF THE OPERATION

The detail of the operation is shown in Figures 5 and 6. The vas deferens is lifted out of its sheath about  $1\frac{1}{2}$  inches above the point where it crosses the mediastinum of the testicle. A small longitudinal nick is made in it and the vas catheterized toward the posterior urethra to determine its patency or colored fluid is injected for the same purpose as should be done in all operations for obstructive sterility. A blunt vasotomy needle is inserted downward toward the epididymis through the opening in the vas and the vas then divided over the needle at the point where it crosses the mediastinum of the testicle. The upper end of the vas is split in two or three parts and 000 catgut sutures inserted through the split

ends with a No. 23 gauge hypodermic needle. All the suturing and running through of the silkworm is done with hypodermic needles as in the fine blood vessel and vas anastomosis recommended by Belfield (1). The vasotomy needle in the vas is threaded with a fine silkworm and then removed.

A long No. 23 gauge needle is inserted through the posterior convex surface of the testicle with its point emerging at the rete in the mediastinum. At this point of emergence the tunica is split for a distance of one fourth of an inch and the rete incised. A slide is taken now or preferably beforehand from the incised rete to determine the presence of sperm as is done in all operations from the point where the anastomosis is to be made. The needle running through the testicle is threaded with the silkworm in the vas and with drawn, so that the silkworm is now through the testicle and vas. The sutures in the split end of the vas are united to the tunica of the testicle which has been incised and the ends of the vas dipped somewhat into the rete and the sutures then tied. The silkworm is carried out on the skin on both sides and then tied. It is left in place 7 to 10 days before removal.

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# EDITORIALS

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## SURGERY, GYNECOLOGY AND OBSTETRICS

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OCTOBER, 1927

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### PRESENT DAY REQUIREMENTS IN ANÆSTHESIA

THE patient of today is no longer satisfied merely to be spared pain during operation. He may demand a local or a general anæsthetic. Those who seek unconsciousness complain unless induction and recovery are as short and as pleasant as possible. If local methods of inducing anæsthesia fail or are not available, disappointment may be keen. The surgeon requires of the anæsthetist that the operative field be quiet and relaxed for the use of either cautery or knife. Both patient and surgeon demand that the anæsthesia shall be as free as possible from immediate and remote dangers and complications.

The environments and the many diseases complicating the life of man have produced grave risks which many times challenge the best efforts not only of the surgeon but of the anæsthetist. As surgeons gain confidence in themselves and in their associates, more cases entailing grave risks are brought to the operating room. Thus to the demands of the surgeon and the average patient are added those of a body racked by disease. If any of these

demands are ignored, satisfactory results are difficult to obtain. Even the skilled surgeon often secures with difficulty some of the splendid results accomplished by modern surgery, unless the operative field is quiet and relaxed, as well as sterile and insensitive.

The anæsthetist administering chloroform was so successful in meeting most of these demands that many years elapsed after the dangers of this type of anæsthetic were well known before surgeon and anæsthetist were willing to forego its benefits. But gradually the use of ether by the open drop method became almost universal. The relaxation was usually sufficient, but the operative field was not quiet because of uneven or labored respiration except in deep anæsthesia. Some unpleasant postoperative effects, chiefly nausea and vomiting, made some patients dread ether anæsthesia more than the operation.

The surgeon's dread of chloroform and the patient's distaste for ether grew apace, so that it was not surprising that gaseous and local anæsthetic agents, primarily advocated especially when the surgical risk was grave, were more or less successfully applied when the risk was not serious. As a result almost every type of operation was performed by the aid of, or in spite of, any one of a number of anæsthetic agents. In the last few years anæsthetists have gradually adjusted themselves to the advantages of the older and newer methods, so that now there is a tendency to use those agents which, alone or in combination, provide quiet and relaxation without untoward effect postoperatively. This is especially noticeable whenever the surgeon

encourages the anæsthetist to become proficient in the use of many anæsthetic agents and in more than one way of employing each. It is quite likely in the future development of anæsthesia that more and more emphasis will be placed on relaxation and the anæsthetist's popularity will depend on his ability to supply such relaxation without adding avoidable elements of danger or unpleasantness.

The quest for such a technique which adds the desirable results of chloroform to the relative safety of ether, is gradually carrying us away from deep anæsthesia by inhalation methods alone. Morphine and oil ether colonic anæsthesia provides quiet respiration and relaxation and in skilled hands is apparently safe but the method is obviously open to improvement. Fortunately improvements are being constantly made in its use.

Sacral block anæsthesia is so satisfactory for excision of hæmorrhoids that when properly applied it is the most finished work of the present day anæsthetist and has satisfied both patient and surgeon.

Methods of inducing local anæsthesia for operations in many parts of the body have often been unsatisfactory unless combined with morphine pre-operatively and light general anæsthesia. The absence of periods of cyanosis and tramping has been particularly noticeable in recently light general anæsthesia when carbon dioxide has been available. The extensive use of carbon dioxide is recent and its place in anæsthesia technique is debated.

Certainly there is no ideal routine anæsthetic agent in general use at the present time although almost any operation may be painlessly performed by the use of any one of a dozen or more anæsthetic agents. Organic chemists have been unusually successful in synthesizing new agents which are capable of producing local anæsthesia. A great deal of

progress in the future may be expected from such efforts. The time may come when safe general anæsthesia and muscular relaxation can be produced by agents injected hypodermically. At the present time the greatest promise of progress is held out by a more and more careful application of the known anæsthetic agent or agents best suited to the patient and his peculiar physical condition; there is little place for routine in anæsthesia.

JOHN S. LUNDY

### PHYSICS AND THE PHYSICIAN

PREMEDICAL students often lose sight of the fact that the term physician was probably originally applied to the man who treats bodily ills, because of his acknowledged familiarity with certain laws of nature they may have overlooked the significance of its origin from the Greek word meaning nature. Students are likely to feel that physics is a science (to which is appended a number of necessary credits toward graduation) and that the particular division called mechanics is important only for students of engineering.

On the contrary, an understanding of the fundamental laws of mechanics is essential to the creditable treatment of the injuries of the back and extremities. The shipwrecks that at times drift into the care of the orthopedic surgeon indicate either that not every one is fitted by nature to deal with mechanical problems or else that the training of certain practitioners has been inadequate. For instance many cases of non union following fracture of the humerus are seen that have been obviously inefficiently treated by a cast extending only from the wrist to the axilla instead of from the wrist over the arm and body to immobilize not only the elbow but also the shoulder joint. Again the ever present ischæmic contrac-

tures, following fracture of the leg as well as of the arm, are a gloomy reminder of an inadequate appreciation of the mechanics of circulation as well as of the mechanics of bone and muscle. Looking on the brighter side, some of the best work in the treatment of the injured has been done by the practitioner working alone, meeting the needs of his patients with a good supply of ready knowledge combined with common sense. Hugh Owen Thomas was such a man, working in his own way, hammering out his own splints for the many traumatic cases that came to him from the docks of Liverpool, he gave excellent service to his patients and left us the heritage of many useful appliances. Among these is the Thomas caliper splint which is now used in so many ways for disabilities of the lower extremity.

An important part of modern industrial and traumatic surgery is the treatment of fractures. Questions are often asked about the proper treatment of fractures of the humerus, femur and other bones. It is not well to outline many iron clad rules for all fractures, for fractures even in the same region of a bone often vary considerably. It is well to be familiar with the various appliances used, but it is better to consider each case an independent problem and to attempt to satisfy the de-

mands of the basic mechanical laws governing the situation. For the reduction of the fracture itself some understanding of the laws of force and the laws of fulcrums and levers is essential. In maintaining the reduction, vigilance is necessary to insure that the retentive apparatus is actually functioning.

Laws of nature that may be expressed in formulas are likely to frighten us. In fact however, formulas simplify the matter by expressing a law in terms that are universally applicable. Complex as some problems in physics become, it is fortunate for us that the laws which we need most are as simple as they are important.

The importance of proper mechanics in reconstructive surgery is nowhere more aptly summarized than by Hippocrates<sup>1</sup> in describing a splint which he used for fractures of the leg. He wrote "If properly managed, this is an excellent contrivance, but if any of them (parts of the splint) do not fit properly, it does more harm than good. And all other mechanical contrivances should either be properly done, or not be had recourse to at all, for it is a disgraceful and awkward thing to use mechanical means in an unmechanical way."

HUGH T. JONES

<sup>1</sup>The Genuine Works of Hippocrates translated from the Greek by Francis Adams LL.D. Printed for the Sydenham Society London 1849 vol. II p. 539

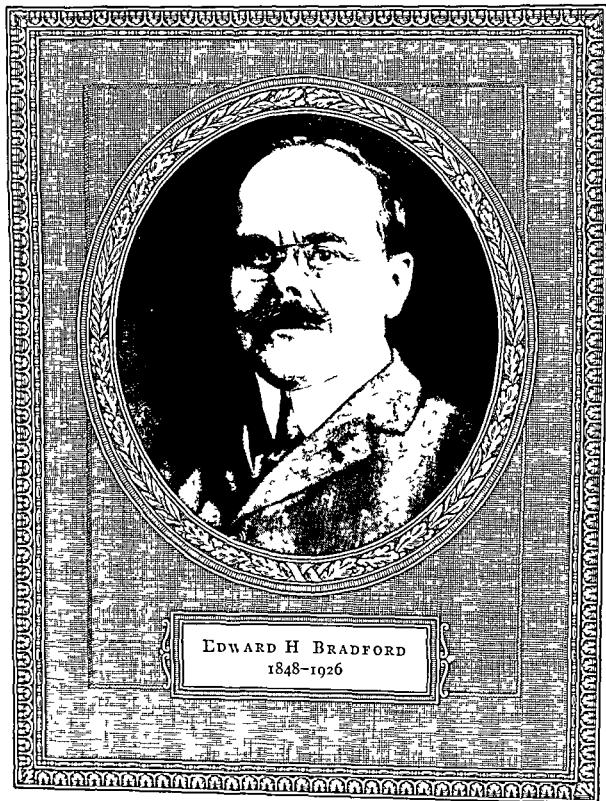
# MASTER SURGEONS OF AMERICA

## EDWARD HICKLING BRADFORD

**D**R BRADFORD was a prominent figure in the group of Boston surgeons during the last part of the nineteenth century and the early part of the twentieth. While he always maintained a lively interest in general surgery and held at times a number of positions which required much purely surgical work, his special concern and his principal activities lay along the lines of orthopedic surgery, in which specialty he was one of the outstanding pioneers in America.

He was born in Boston, June 9, 1848, being descended from old New England stock—an early governor of the State being one of his direct ancestors. After a preliminary education in the preparatory schools, he entered Harvard College, and graduated in 1869. He then began his medical education at the Harvard Medical School, where he graduated in 1873, receiving the degree of M.D. Crossing then to Europe, he passed two years in visiting the various medical centers, where he attended lectures and clinics. While in England he worked many months with Dr. Owen Thomas of Liverpool, a pioneer in joint surgery and the inventor of the splint called after his name. Upon his return to America, he went to New York, and there followed the surgical work of Dr. Charles Fayette Taylor. Finally he came back to Boston, where he established himself, and began the practice of his profession.

For a long period he worked with Dr. Buckminster Brown at the House of the Good Samaritan. This institution was the first one in Boston where the bone and joint diseases of children were regarded as belonging to a special branch of surgery, and where, as such, they were carefully studied and treated. In course of time Dr. Bradford succeeded Dr. Brown as surgeon in charge of this institution. Early in his career, he was invited to join the surgical department of the Boston City Hospital, and of the Boston Dispensary, and also that of the Children's Hospital, at all of which institutions he worked hard and faithfully for many years, gaining much valuable experience, and being gradually promoted from one grade to another until in all of them he reached the highest position. As time went on, he devoted more and more of his attention and energies to orthopedic surgery, and for this reason he became more and more closely associated with the Children's Hospital, and it was largely here that he thought out and made known the correct pathology of congenital dislocation of the hip, and later



EDWARD H BRADFORD  
1848-1926





instituted the proper methods for its treatment. He also invented, for the treatment of Pott's disease, the simple and useful frame which ever since then has borne his name. Of the many other pieces of orthopedic apparatus brought out by him may be mentioned the Bradford abduction hip splint, which has been very successfully used in the ambulatory treatment of caries of the hip joint.

In 1880, he joined the surgical department of the Harvard Medical School, with the title of clinical instructor of orthopedic surgery, and he was gradually promoted until in 1903, he was made full professor, being the first person to hold the Buckminster Brown professorship of orthopedic surgery. He retained this position until 1912, and, during this long time (1880-1912), except for a brief period, he gave much of his time and attention to teaching. In this he was very practical, and he believed emphatically in the use of models and illustrations of all kinds to make clear his points. In the course of his teaching, he used a very large collection of lantern slides, a collection which he himself had made, and which he later presented to the School. In 1912 he was made Dean of the School, and he discharged the duties of this office for six years. During this time, and in fact for the rest of his life, he was greatly interested in the welfare of the students, with whom he tried always to keep in very close personal touch. To use the words of President Lowell "He gave a new birth to orthopedic surgery in this country, and his administration as Dean prepared the way for the developments of the School that have since taken place." In 1919, he was elected an overseer of Harvard College, and his interest in the College and the School never abated. The Board of Overseers of the College voted, some weeks previous to his death to confer upon him the degree of doctor of science (S D ) and this decision was announced by President Lowell at Commencement, June 24, 1926.

He belonged to a number of professional societies, national as well as local, and he was constant in his attendance at meetings, he himself making frequent contributions. His book on *Orthopedic Surgery*, which, with the late Dr. Robert W. Lovett, he published after his many years of rich experience, marked a distinct epoch in the development of the specialty of which it treated, and it went through five editions.

Although most of his time was passed in attending to his work at the hospitals and at the medical school, as well as to his own private practice, an extensive one, he found opportunity also for other activities, for he was president of the trustees of the Massachusetts Eye and Ear Infirmary, chairman of the board of trustees of the Massachusetts Hospital School (Canton, Massachusetts), a trustee of the School for Crippled and Deformed Children, a trustee of Simmons College from the time of its inception, and a trustee of the Boston Library Association, an institution founded in 1791.

During the Spanish War, and also during the World War, he offered his services to the Government, and as they were accepted, he did for the country

during those trying times much professional and semi professional work, which was of distinct value

All these activities were pursued in spite of gradually increasing impairment of vision, the result of an injury received from an accident in middle life. Toward the end of his life he took up the study of Braille, in order to keep himself in touch with the outside world. He studied hard, became very proficient in its use, and derived much pleasure from it.

Dr Bradford died suddenly of cerebral hæmorrhage on May 7, 1926, in his seventy eighth year. Funeral services conducted by his lifelong friend and class mate Rev. Francis G. Peabody were held in Appleton Chapel in Cambridge (the Chapel of Harvard College) where he had worshipped all his life, and Dr Peabody's eulogy in memory of Dr Bradford was eloquent and touching. Obituary notices appeared in many periodicals in this country and abroad. The *British Medical Journal* among others gave a full account of Dr Bradford's life and works and referred to his loss as that of "a notable figure from the dwindling group of pioneers of orthopedic surgery."

In the high grade work that Dr Bradford by his intelligence, ingenuity and persistent labor has done, he has made a very generous contribution to the world, as indeed all those who are in a position to know fully appreciate.

Besides this he was a man of culture. He was very fond of art, and was familiar with the best works of painting, sculpture and architecture both here and abroad. Few men moreover have been so beloved by their fellows as he was, for his modest and kindly nature combined with his courage and his insistent desire to help others attracted the attention and admiration of all who knew him. To them the thought of Dr Bradford's life and accomplishments but above all the remembrance of his personality, will always be a source of pleasure and of inspiration.

GEORGE H. MONKS

# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING DECEMBER 17, 1906 DR W. A. NEWMAN DORLAND, PRESIDING

### THE LOCAL USE OF ETHER IN GYNECOLOGY

DR GEORGE DE TARLOWSKY read a paper entitled  
The Local Use of Ether in Gynecology

### THE ORTHOPEDIC ASPECT OF LOW BACK PAIN IN CONNECTION WITH PELVIC DISORDER

DR PHILIP H. KREUSCHER (by invitation)  
read a paper on "The Orthopedic Aspect of Low  
Back Pain in Connection with Pelvic Disorder"  
(See p. 45)

#### DISCUSSION

DR A. SPROAT HEAVEN: I know that we have all found much to interest us in Dr. Kreuscher's paper. He has drawn attention to the fact that there are other causes for backache besides diseases of the female genitalia and lays particular emphasis upon the rôle of abnormality of the sacro iliac joint and other bones in the etiology of backache. I believe, however, that gynecologists get more patients with backache than do any other class of doctors, even the orthopedists.

I will not pass by lightly the intimation that retroversion of the uterus is not a frequent cause of backache. If surgeons who make this assertion would preliminarily to a corrective operation for a retroversion try the effect of a pessary first and if the patient were not relieved by a properly fitting pessary refuse to operate in such cases of retroversion there would be fewer disappointed surgeons saying that retroversion never produces backache.

Gynecologists particularly those who are also obstetricians are well acquainted with sacro iliac subluxation as a cause of backache in women, particularly pregnant women. It is surprising how little help the X-ray usually gives in the diagnosis of subluxation of the sacro iliac joint. Even when this condition is present a properly fitting sacro iliac belt does not always give relief. Are we however justified in saying as does Dr. Kreuscher about retroversion that a sacro iliac subluxation never causes backache because the therapy aimed at its relief is not effective? Backache may be caused by worry or anxiety, the same as a headache may be produced by these nervous phenomena. Irritation of the anus and endocervicitis may also produce backache. Dilatation of the ureter and of the kidney pelvis are occasionally found to explain backache.

Spiral constipation may produce backache. We gynecologists know that the causes of backache are manifold and that it is just as erroneous to think that a particular backache is due to a displacement of the uterus and exclude other possible causes as it would be to assume that every backache that a woman has is due to subluxation of the sacro iliac joint.

In closing I wish most emphatically again to reiterate that retroversions of the uterus can produce backache and that if a backache is due to a retroversion a proper corrective operation will relieve it.

DR C. S. BACON: I understand that the subject under discussion is pain in the back and pelvis and not pain limited entirely to the back. I suppose we may also include the subject of pain in the vagina which was discussed very comprehensively and interestingly some months ago by a member of this Society. A neurotic pain may occur anywhere in the body.

The speaker did not refer to the pain that comes on frequently in the small of the back after or during an attack of influenza. I myself had experience with it in the first epidemic and I have had several attacks of that kind since. Dr. Riveron was called in consultation and thought that there must be a dislocation of the sacro iliac joint and ordered a support which I wore with not much more relief than that from an old fashioned hot iron. The pain disappeared after a time. I was not convinced that there was a dislocation. I remember seeing a patient in the Cook County Hospital who had sciatica. After a hypodermic injection of water into the lumbar muscles the man suddenly got up and ran down the ward.

Another factor in pain in the pelvis is the dislocation of the ovary. A displaced ovary is very frequently the cause of pain in the back. If the displacement can be corrected by orthopedic manipulation or perhaps by an operation such as Saenger proposed some 30 years ago relief will be obtained.

Then there is another condition that I have found not at all infrequently. A woman has suffered with a great deal of pain in the back and pelvis and you find the uterus in good position and the ovaries not displaced. By pressing on the pelvic floor you elicit very marked pain reflected over the branches of the sciatic nerve. There is such a thing as sciatic pain in the branches of the nerve. It is similar to

*intercostal neuralgia* I agree with Dr Heaney that there are many different causes of backache.

DR HENRY SCHMITZ If we could locate points of sensitiveness that would indicate the seat of the lesion in the pelvis the problem of differential diagnosis would be greatly facilitated. Heat has pointed out definite areas of skin sensitiveness in disease of the pelvic organs. For instance in ovarian disease the skin sensitiveness would be over the tenth thoracic segment in diseases of the tubes over the eleventh and twelfth segments. Erosion and endocervicitis cause a sensitiveness in the third and fourth sacral segments. We have for many years observed these findings and find them a great aid in the differential diagnosis of low backache.

One condition was not mentioned which I think is often the cause of backache in elderly women—the so called atrophic form of parametritis which may be responsible for some of the most severe backaches. Unfortunately very little can be done to relieve these women. Retroversion of the uterus may cause backache as Dr Heaney pointed out. The best way to prove this is to replace the uterus and keep it in anteversion by a pessary. If the backache is due to such a displacement it should disappear after replacement. Another common cause of backaches which is frequently overlooked is the unilateral or bilateral backache due to a pathological condition of the kidney. If resort was had to routine cystoscopic and kidney examinations quite a number of patients could be helped. If all these means at the command of the gynecologist have been exhausted the orthopedic surgeon may then be consulted to aid in the search for a cause.

DR J B DELEE I have just a few points to bring out. One can often prognosticate whether a patient is going to have a backache after the delivery of her baby. If she belongs to the status hypoplasticus type she is likely to have backache. The mesoblastic tissues do not provide sufficient support and the strain of pregnancy proves too much. I would also like to suggest that during X ray examination a little traction be put on the leg while the picture is being taken. You sometimes find that the separation is much more marked in that than in the normal position.

I think that Dr Kreuscher is wrong when he says that the sacrum is a keystone. It is shaped like a keystone but it fits into the pelvis in a manner just opposite to that shown in the pictures on the screen. The pelvic ligaments become softer during pregnancy and stretch during labor and the backache is the result of the dislocation of the sacrum produced by the passing of the child the mesoblastic structures being already below par. I have noticed that women of the dystrophic type are not so likely to have backache. I have also noticed that women delivered by caesarean section rarely

have backache. I have also noticed that the women delivered with forceps instead of being allowed to go on for hours and hours in the second stage are less likely to have a backache.

I am glad that Dr Heaney and Dr Schmitz emphasized that inflammation of the sacro iliac joints is a cause of backache. It is too easy to say that the backache is the result of uterine displacement and I am inclined to disagree with my colleague. I think that the vast majority of backaches in women are caused by conditions outside the pelvis.

DR R A SCOTT I think that every man dreads to see a woman come into the office with backache because there are so many different causes for it. Recently a well known urologist in speaking to me said that backache in women was due in a great majority of cases to ureteral obstruction. In a well organized gynecological clinic in Boston which I attended the patients complaining of backache were first sent to the roentgen ray department which I think is a very good routine practice. I think Dr Kreuscher in his paper has proved that very conclusively.

DR PHILIP H KREUSCHER (closing) I wish to thank the officers for giving me this invitation. I wish to thank the men for the discussion of the paper. How fortunate it is that we do not all wear the same colored glasses. If we all wore rose colored glasses everything would be rosy all the time. We see things through our own glasses. We naturally remember those cases which are cured or relieved by the things we do for them. We forget sometimes the cases that are not relieved by the things we do for them. That applies to me and to you. We do not believe that belts and corsets correct these deformities. I tried to show you that belts, corsets and even immobilization in bed with a Goldthwaite belt around the pelvis do not cure them. There are certain other conditions that must be taken into consideration. This I tried to show by saying that we must correct the deformity if there is one that we must try to correct the alinement of the sacrum. With all due respect to Dr DeLee I contend that the sacrum is wider at the top than at the bottom. An examination of a skeleton pelvis should convince us that the sacrum is wedge shaped and the wide portion of this wedge is at the top.

Dr Heaney spoke of the cancer backache. There are those no doubt as well as the fatigue backaches. The men who do much industrial surgery will tell you that very often their companies are forced to make a settlement in these cases of malignancy.

I am very much interested in what one of the doctors said about trial therapeutics. I was never a great believer in any appliance or method devised for the relief of a painful back which did not have a common sense mechanical or physiological basis.

# CORRESPONDENCE

## THE BALDWIN OPERATION FOR THE FORMATION OF AN ARTIFICIAL VAGINA

*To the Editor* The article under the above title by Judin of Russia appearing in your April issue contains a number of statements, some of which I have seen in other publications on the same subject, and every one of which it seems to me should be corrected.

1 In my description of the operation, and in all my subsequent descriptions, I advised the use of the lower end of the ileum for the formation of the new vagina, but stated that if for any reason that part of the bowel was not available the sigmoid could almost certainly be used instead. Before publishing my description I had examined the mesentery in many hundreds of cases, in which the abdomen had been opened for various reasons, and had always found it ample for the purpose in mind and in my own work since then I have had no trouble whatever in using that portion of bowel.

2 The length of bowel utilized is to be no more than enough to make a normal vagina. By using only that amount I have never had the slightest complaint of any leucorrhoeal discharge. In Judin's article the X ray pictures show that a large surplus of bowel was taken and necessarily there would be a more or less annoying mucous discharge, while with the proper amount there would be no more than the normal moisture.

3 The opening for the vagina should be made by a transverse incision at the proper point in the perineum, where a line of cleavage will be found so that the separation of bladder and rectum can be accomplished rapidly and with the utmost safety. The only difficulty I have ever encountered was in a case in which an attempt had been made at the formation of a vagina by making an opening and packing it with gauze. Naturally the expectation that the opening would persist failed but the result was a mass of scar tissue which rendered the operation very difficult, though fortunately there was no wounding of either bladder or rectum and the result was perfect.

4 The closure of each end of the resected bowel by purse string requires a minimum of time and there is an absolute minimum of chance for infection and it is infection which is naturally the only real danger in the operation.

5 Careful examination of the mesentery at the proposed point should be made so as to determine the blood supply, and usually the continuity of the intestinal canal can be restored by the ordinary lateral anastomosis both ends having been previously closed by inversion and purse string. A

Murphy button can be used if haste is required, or if the end of the ileum attached to the cæcum is too short for lateral anastomosis.

6 A hole is torn in the mesentery at the center of the resected bowel through which is passed a strip of gauze, which strip being caught by a clamp enables the bowel to be pulled down to the perineum without laceration. The fingers of the operator can be used to assist its passage from above and then to close over the peritoneum at the bottom of the pelvis so as to leave a minimum of raw surface. This part of the technique being completed (usually with removal of the appendix) the abdominal incision is closed.

7 The bowel protruding at the perineum is then opened with scissors and the edges of the opening attached around to the adjacent skin by chromic catgut stitches. Each half of the bowel is then wiped out and lightly packed with iodoform gauze so as to secure pressure sufficient to obviate oozing and to maintain the full size of the passage. If there seems to be any necessity for drainage a little cigarette drain is passed upward behind the bowel to be removed in 24 or 48 hours.

8 The gauze packing can be left in for several days and when removed each side of the loop can be washed out with a little stream of hot water with perhaps some mild antiseptic added if this is indicated.

9 At the end of two weeks a clamp is applied to the septum between the two halves of bowel which is crushed, the clamp being allowed to remain in position until it cuts its way through. If the blades of the clamp are not long enough a second application can be made so that the septum is finally divided through its entire length and a single passage remains.

10 The mortality should be practically no greater than that of an ordinary intestinal resection, since the additional work necessary should not give rise to any hæmorrhage or shock. I have had but one death in my own work (5 per cent), and in that case I am quite certain there would have been no fatality had it not been that the patient and her husband were ignorant foreigners and I was not permitted to practice stomach lavage, stimulating enemas, or other means of relief. So far as I know no attempt has been made in this country to tabulate any statistics, but from numerous reports which have been made to me by individual surgeons the mortality here must be very much less than that reported from foreign sources by Judin. Possibly the difference is due to departure from the original technique.

71 With increasing experience with the operation I have seen no reason to change the technique originally described. I have studied the suggestions as to changes which have been made from time to time but all of them seem to be based on incomplete study of the conditions present.

A year or two ago Allen B. Kanavel the well known surgeon of Chicago in showing me a patient who was just ready to go home told me that he had himself made a careful study of the original technique and of all the suggestions as to changes and had decided to follow the operation as originally described.

J. F. BALWIN

Columbus Ohio April 11 1927

#### OPERATIVE TREATMENT OF OBSTRUCTION DUE TO A GROWTH IN THE DESCENDING COLON—A CORRECTION

IN the article by Dr. Jan Schoemaker on the Operative Treatment of Obstruction Due to a Growth in the Descending Colon appearing in the September issue pages 359-363 we wish to make the following corrections:

Under the heading Second Stage fourth paragraph third sentence should read: The only fixation of the colon now is the transparent anterior layer of the mesocolon. In the same section in the fifth paragraph the fourth sentence should read: In this way we produce a 5 millimeter sleeve of mucosa plus submucosa. THE EDITOR

### BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**TROPICAL SURGERY AND SURGICAL PATHOLOGY** By Karuna K. Chatterji. I.R.C.S.I. Major I.T.F. Medical Corps. With a Foreword by Major General Sir R. Havelock Charles G.C.V.O. K.C.S.I. M.D. LL.D. M.Ch. I.R.C.S.I. I.M.S. (Ret.) New York: William Wood & Company 1927.

**FUNDAMENTALS OF THE ART OF SURGERY** By John H. Watson. M.B.S. (Lond.) F.R.C.S. (Eng.) New York: Paul B. Hoeber Inc. 1927.

**MALARIAL PSYCHOSES AND NEUROSES WITH CHAPTERS MEDICO LEGAL AND ON HYPERTHYROID DEGENERATION ALCOHOL AND SURGERY IN RELATION TO MALARIA** By William K. Anderson. M.D. F.R.C.P.S. (Glas.) New York: Oxford University Press 1927.

**DIRECTORY OF THE AMERICAN BOARD FOR OPHTHALMIC EXAMINATIONS** Vol. 1. 1927.

**A HANDBOOK OF DISEASES OF THE STOMACH** By Stanley Wyard. M.D. B.S. M.R.C.P. New York: Oxford University Press 1927.

**DIE CHIRURGISCHE BEHANDLUNG DER GEHIRNTUMOREN EINE KLINISCHE STUDIE** By Dr. Herbert Olivecrona. With co-operation of Dr. T. Lysholm. Berlin: Julius Springer 1927.

**INTRACRANIAL TUMOURS AND SOME ERRORS IN THEIR DIAGNOSIS** By Sir James Purves Stewart. K.C.M.G. C.B. M.D. (Edin.) I.R.C.P. New York: Oxford University Press 1927.

**SURGICAL ANATOMY OF THE HUMAN BODY** By John B. Deaver. M.D. Sc.D. LL.D. F.A.C.S. 3d ed. in three volumes revised and rearranged. Vol. III. Philadelphia: P. Blakiston & Son 1927.

**THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR** Volume XI. Surgery. Part One—General Surgery. Orthopedic Surgery. Neurosurgery. Prepared under the direction of Maj. Gen. W. W. Ireland. Washington: Government Printing Office 1927.

**METHODS AND PROBLEMS OF MEDICAL EDUCATION** New York: The Rockefeller Foundation 1927.

**CITY HEALTH ADMINISTRATION** By Carl E. McCombs. M.D. New York: The Macmillan Company 1927.

**CYSTOSCOPY A THEORETICAL AND PRACTICAL HANDBOOK CONTAINING CHAPTERS ON SEPARATE RENAL FUNCTION AND PYELOGRAPHY** By Jas. B. Macalpine. F.R.C.S. (Eng.) New York: William Wood and Company 1927.

**PRACTICAL LECTURES ON THE SPECIALTIES OF MEDICINE AND SURGERY** Delivered under the Auspices of The Medical Society of the County of Kings. Brooklyn: New York Second series 1924-1926. New York: Paul B. Hoeber 1927.

**PLANT AUTOGRAPHS AND THEIR REVELATIONS** By Sir Jagadis Chunder Bose. M.A. D.Sc. LL.D. F.R.S. C.S.I. C.I.E. New York: The Macmillan Company 1927.

**HERNIA AND HERNIOPLASTY** By Ern. St. M. Cow. B.S.O. M.D. B.S. (Lond.) F.R.C.S. (Eng.) With an Introduction by Sir Arthur Keith. F.R.C.S. F.R.S. New York: Paul B. Hoeber 1927.

**PHYSEER MEDICINE IN WESTERN PENNSYLVANIA** By Theodore Diller. M.D. With a Foreword by J. J. Buchanan. M.D. New York: Paul B. Hoeber 1927.

**DIE GESCHLECHTSKAEFTE DER FRAU** (Ein Psychopathologie des weiblichen Liebeslebens.) By Dr. Wilhelm Stekel. 3d ed. rev. Berlin: Urban & Schwarzenberg 1927.

**BIOLOGIE UND PATHOLOGIE DES WEIBES EIN HANDBUCH DER FRAUENHEILKUNDE UND GEBURTHSHILFE** Joseph Halban and Ludwig Seitz. Lieferungen 34, 35, 36, 37. Berlin and Wien: Urban & Schwarzenberg 1927.

**INTERNATIONAL CLINICS A QUARTERLY OF ILLUSTRATED CLINICAL LECTURES AND ESPECIALLY PREPARED ORIGINAL ARTICLES ON TREATMENT MEDICINE SURGERY ETC.** Edited by Henry W. Cattell. A.M. M.D. Vol. 1. 1927. Philadelphia and London: J. B. Lippincott 1927.

**A POCKET GUIDE TO MEDICAL LIFE ASSURANCE** Compiled by Jehangir J. Cursetji. M.D. L.R.C.P. L.R.C.S. 2d ed. rev. Bombay: Times Press 1927.

**MORTALITY STATISTICS 1924** Department of Commerce. Bureau of the Census. Twenty-fifth Annual Report. Washington: United States Government Printing Office 1927.

**LA PYÉLÉSCOPIE** By F. Legueneu. Bernard Ty and Pierre Truchot. Paris: Norbert Moloue 1927.

**L'ANGINE DE POITRINE ET L'ANGINE ABDOMINALE** By D. Danileopolu. Paris: Masson et Cie 1927.

**LA PRATIQUE CHIRURGICALE ILLUSTREE** Volume II. Victor Jauchet. Paris: Gaston Doin & Cie 1927.

**ANGINA PECTORIS THE ANATOMY PHYSIOLOGY AND SURGICAL TREATMENT** By Walter B. Coffey. M.D. F.A.C.S. Philip King Brown. A.B. M.D. and John Davis Humber. B.S. M.D. 1st ed. New Orleans: J. Dickinson 1927.

**A TEXT BOOK OF PSYCHIATRY FOR STUDENTS AND PRACTITIONERS** By D. K. Henderson. M.D. (Edin.) F.R.F.P.S. (Glas.) and R.D. Gillespie. M.D. (Glas.) D.M. New York: Oxford University Press 1927.





## REVIEWS OF NEW BOOKS

TEN lectures by English doctors authorities on the health of the child have been published in a small volume.<sup>1</sup> These lectures were delivered under the auspices of the Institute of Hygiene of England and give an indication of the ever increasing stress placed on keeping the child well correcting incipient deformities and therefore building up a stronger race for the future.

The ten lectures cover the following subjects: the dental problem in relation to school children; the prevention of nervous affections in the young; diet in school disorders of digestion during school life; the incidence of infectious diseases in public schools; affections of the nose, throat and ear; the eye troubles of school life; some disorders of the skin during school life; the value of sport and physical exercise; preventable deformities in childhood and adolescence.

Many of the problems dealt with are not strictly applicable to American life because the mode of life and food habits discussed are different.

The book is of particular value to physicians doing school work and particularly those in attendance at boarding schools. Most of the subject matter is given in an elementary manner and is meant for the layman. It refers more often to large groups of children in boarding schools and gives some good ideas of the responsibility involved by the school physician in not only looking after acute illnesses but safeguarding teeth, supervising exercises, watching diets and generally overseeing everything which involves the health of the child.

It is a book any parent with a child of school age can read with profit.

GERARD A. KROST

IN a monograph<sup>2</sup> of a little over 100 pages Bauer covers the subject of fractures and dislocations quite completely giving however much more space to the mechanism, symptoms and pathology of these two divisions of surgery than the average practitioner will spend time to read. Possibly criticism of the practitioner of this country is uncalled for in that connection but the sincerely interested surgeon cannot help but wish that a deeper understanding of these divisions of the subject were better taught and understood. To paraphrase one may say possibly *autres pays autres moeurs*.

If we assume that the knowledge of the mechanism and pathology of fractures and dislocations is an essential in their treatment we find this a helpful instructive book. The illustrations are well selected and uniform but are mostly reproductions of roentgenograms with the addition of several

pathological specimens. From the standpoint of the busy practitioner however many of his important problems are scantily dealt with. Ankle fractures for instance are dismissed with one page of discussion. The surgeon will find the work an excellent compend of the latest German ideas on the subjects of fractures and dislocations.

K. FLICCG SPEED

LEVINE'S *Practical Otology*<sup>3</sup> is a most readable book. It is sure of a warm welcome from otologists not only from its own merits but also from the sympathetic foreword written by Dr. James McKernon. It is a volume of 380 pages and represents a compilation of lectures given by the author at the New York Post Graduate Medical School and Hospital. The subject is presented as fully and clearly as is necessary in a textbook. The practical application of tests are so stated that little difficulty should be met with in applying them. The paragraphs on treatment are excellent.

The chapter which we find ourselves least in agreement with is the one in which vertigo is discussed. The author lays too much emphasis on the semicircular canals as the cause of these symptoms. It seems to us that he has overstated his case. What proof is there that vertigo in renal insufficiency is due to stimulation of the semicircular canals (page 143) or that in cardiovascular diseases it is due to insufficiency of the blood supply to the labyrinth (page 144)? The emphasis ought to be laid on the vestibular pathway and its connection and less on the peripheral end-organ. In the same chapter sea sickness is also considered. With our present knowledge no one will object in a textbook of this nature to the assigning of the causation of this malady to labyrinthine disturbances. But when the author in order to strengthen this causation states that the absence of sea sickness in infants is due to incomplete development of the equilibratory organ (page 147) meaning thereby (see preceding sentence) the vestibule and semicircular canals, one objects. If he means that the labyrinth is poorly developed at this age it is not so. If he means that the higher associations of the vestibular part are not fully linked up then he has a better ground to base an argument on.

The chapter on deaf mutism is worthy of consideration not only by otologists but by the general practitioner to whom as a rule the parents first bring these cases and who is in close touch with them for years.

As has been stated above the practical part of the work is its best. As an example one would call attention to the chapter on the simple mastoid operation. This textbook we have no hesitation to

<sup>1</sup>THE HEALTH OF THE CHILD OF SCHOOL AGE. By various authors. The Health of the Child of School Age. M. D. F. R. C. P. L. L. D. D. C. L. W. J. K. O. S. D. L. V. P. S. 1917.

<sup>2</sup>FRACTURES UND LUXATIONEN. K. ref. tes Lehrbuch. A. te. und Stud. d. By D. M. d. K. H. B. Bel. J. l. s. Sp. g.

<sup>3</sup>PR. CTIC L. OTOL. OGY. By M. r. Le. n. M. D. Ph. d. l. ph. l. e. & Feb. 1917.

recommend it to ophthalmologists and to students of medicine. The general practitioner will find it a handy volume to which he can refer for general information on ophthalmology and treatment.

J. GARDNER WILSON

THE four lectures by Professor Faber included in *Lectures on Internal Medicine* are of great interest to the internist. They were given during a visit to the United States in 1905, the last of the Harvey Lectures of this year. The pathogenesis of achylia gastrica, considered first, has hitherto been obscure. It is usually thought of as functional or "nervous." The work outlined here is another example of the truth of the old saying "Dix Me hodie adest." Faber injected the abdomen with 10 per cent normal saline solution immediately after death thus obtaining clear pathological pictures of the stomach. His conclusion from this study is the achylia gastrica is a result of disease of the gastric mucous membrane which is entirely analogous to some of the infectious conditions in other parenchymatous organs. The recent success of liver feeding in the treatment of pernicious anemia makes the next lecture on the intestinal origin of this disease particularly interesting. His essential thought is that the anemia results from toxins usual, but not necessarily derived from the intestine. How the demonstrated potency of a few grams of non-protein non-vitamin liver extract has in this theory is as yet difficult to understand. The third lecture analyzes glycosuria in an instructive way. The Harvey Lecture is an historical outline of medical therapy. It presents the epoch making changes of the last hundred years. Louis overthrew the ancient and universal practice of phlebotomy came as the result of his method of clinical examination till so necessary in proving a therapeutic procedure in the clinic as one would test a pharmacological principle in the laboratory by controlled repetition. This led to an age of therapeutic nihilism which has finally given way to credulity again, because of the wealth of possibilities offered the clinician by the biological sciences. The lectures are instructive and stimulating full of careful work, sound analysis and elevating thought.

PATRICK FENLEY

principles as applied to the diagnosis and treatment of diseases of women—a text free from the technical details and to be referred to with operative technique. None should be required in a text. It is indeed, heaven to find a text book written for students and physicians—rather than one that attempts to fill the need of the student and practitioner. The overwhelming demand for our schools will bring an increased demand for such texts as this presented by Dr. Funk. We commend it to the author and the publishers.

PATRICK FENLEY

A MOST unique production and one that will serve a limited but useful purpose is Gray's *Notes of Gynecology*. The book contains outlines of the entire subject of gynecology. It is so concise a text and is so arranged as to be used. The subjects are presented in a concise, orderly manner admirably suited to the needs of the student who is preparing for examination. As a means of rapid review of the subject the work deserves the highest commendation. It may almost be said that there is not a superfluous word in the text and yet the completeness of a complete within twelve weeks upon completion. To the young internist the book will serve as a guide in the preparation of his lectures and he will probably feel no need to rely on any from the book as a text.

The reviewer has taken occasion to submit these outlines to several general surgeons and general practitioners for the purpose of eliciting their opinions. The universal comment was that the work is admirable adapted to their needs as a text reference.

PATRICK FENLEY

WILLIAM KNOW IRWIN, of London, has completed his revised and enlarged second edition of *Urology Surgery*, a handbook for the general practitioner. In a sense the time is a masterpiece. The book is really an excellent synopsis of modern urological principles.

The author has departed from the strictly personal arrangement of subject matter. The chapters deal with the anatomy concerned in urology and then followed by a short but lucid discussion on the examination of the patient. The next seven chapters have to do with the diagnosis of the urological patient, their cause and treatment. Such important and pressing subjects as incontinence of urine, prostatic difficulties, retention of urine, urological path, hematuria and pyuria are clearly discussed. The chapter on renal prostatic enlargement should be read by every general practitioner if he does not already know the principles of diagnosis and treatment which urologists are constantly trying to teach. The book

is published by GUTHRIE, 101, by Arthur Giff F.R.C.S., M.R.C.P. New York, Lippincott, Green & Co., 171.

DEWEY SCHUBERT, a HANDY BOOK FOR THE GENERAL PRACTITIONER BY WILLIAM KNOW IRWIN, M.D., F.R.C.S., L.R.C.P., 1907, 220 pages, New York, William Wood and Company, 1907.

LECTURES ON INTERNAL MEDICINE, delivered in the College of Medicine by JOHN O. FOLK, M.D., New York, Paul B. Hoeber, 1907.

A MANUAL OF GYNECOLOGY, By John O. Folk, F.R.C.S., M.D., F.A.C.S., 3rd ed., Philadelphia, Lea & Febiger, 1907.

fifty pages of the book are devoted to operations on kidneys ureters bladder urethra prostate and penis there is no attempt at detailed descriptions but the subject matter is adequate

This book is recommended for perusal especially by the general practitioner the concepts of pathology and the principles of treatment will serve as a great aid in handling urological problems

HARRY CULVER

A LARGE single volume<sup>1</sup> covering the field of internal medicine including nervous and mental diseases has been written by one hundred and thirty American physicians most of whom are actively engaged in advancing clinical knowledge of the subject upon which they write The articles therefore have a quality of simplicity and reliability which is most refreshing Furthermore one may read on almost any subject with the feeling that he is getting special knowledge rather than the more general and superficial opinion of some one writing second hand as is sometimes true in the single author works Treatment is well emphasized and includes the most recent discoveries Several leading references are given with each article making it a starting point for more extended study This should be a popular students text and attractive to physicians and surgeons because of the authority behind the writings

PAUL STARR

PROFESSOR PORTMANN and Dr Retrouvart<sup>2</sup> have given us a very full description of cancer of the nose its prognosis and treatment in a volume which is one of a series now being published in France on cancer in various parts of the body This particular part will appeal not only to specialists but to the general surgeon

In the work under review each region of the nose is considered separately The pathological anatomy together with the predisposing causes are discussed with sufficient detail The various methods of treatment are fully and critically considered and the statistical data given lend emphasis to the deductions drawn The paragraphs on treatment are a noteworthy feature of the work

The chapters on cancer of the maxillary sinus and of the nasopharynx call for special notice because of the clearness and fullness with which the subject is treated In the former the writers consider neoplasms in this area in three stages First the latent period when the growth is within the sinus second the period of deformation due to the growth and external pressure and third the period of invasion of the surrounding tissues This method of attack gives the authors an admirable means of discussing differential diagnosis and treatment It is during

the latent period that the rhinologist has the greatest difficulties in his diagnosis and these difficulties are fully appreciated by the authors

The chapter on cancer of the nose treats the pathological conditions of clinically benign lesions which may under diverse influences tend to become cancerous such as nasal cystomata cysts keloids and cicatrices of burns and lupus The different methods of treatment occupy a large part of each section The relative merits of diathermy and radium are very well stated especially noteworthy is the chapter attached to cancer of the nasopharynx

The clearness with which the whole subject is treated is typically French This with the details furnished makes the treatise well suited as a work of reference

J GORDON WILSON

IN the wake of the war has come the spread of sports over Europe So enthusiastically have our Gallic cousins taken them up that their surgeons now see numerous instances of disturbance of the semilunar cartilages of the knee joint as a result of which a delightful orderly monograph<sup>3</sup> appears

The work is based on a report made by the authors before the thirty fifth French Surgical Congress and although entitled Pathology of the Menisci of the Knee it deals completely with the subject from a clinical standpoint including treatment both non operative and operative Both the traumatic and pathological alterations including cysts and predegenerations of the cartilage are covered

The illustrations are simple line drawings which are easily understood A commendable feature is the few pages given to interpretation of roentgenograms of the knee Arthroscopy is dismissed at about its true value A good bibliography is attached

This book is a concise reference for the surgeon dealing with these injuries

KELLOGG CREED

I FIRST became acquainted with Bings Compendium<sup>4</sup> as a student probably because it belonged to that group of compendia which included surgery and medicine and were the objects of derision from our instructors The latter obviously went in for large and weighty volumes and often the owners of these compendia were the recipients of spiritual and material punishment This particular compendium was popular because in it clinical neurology was shorn of its Mephistophelean disguise and was shown to be the offspring of parents both of whom we had met before neuroanatomy and neurophysiology

In a way neurologists are to blame for the spite of hopelessness which students and practitioners

PATHEMOE DES MENISQUES DU GENOU By Albert Mouchet d'Loire et de la Faculté de Médecine de G. 1927

COMPENDIUM OF REGIONAL DIAGNOSIS IN AFFECTIONS OF THE BRAIN AND SPINAL CORD A CONCISE INTRODUCTION TO THE PRINCIPLES OF CLINICAL LOCALIZATION OF DISEASES AND INJURIES OF THE CENTRAL NERVOUS SYSTEM By F. B. G. T. A. 1927

A TEXT BOOK OF MEDICINE BY AMERICAN AUTHORS Edited by R. C. Cecil A. B. M. D. Assoc. to Fed. of Disease of the Nervous System by Foster Kennedy M. D. F. R. S. Edinb. and London W. B. Saunders Company 97

BIBLIOTHEQUE DU CANCER Le Cancer du Nez DES FOSSÉS NASALES DES LAUVIÈRES ACCÉSSOIRES ET DU NASO-PHARYNX By Geo. Des P. tinnans and H. J. K. tinnans Cast. a Do. & Co. 1927

exhibit toward their chosen field. Few of them who write are able to do so clearly and simply. It is as if they made their subject appear more difficult to strengthen their own defensive mechanisms. At any rate the third edition of the translation from the sixth German edition testifies to the popularity of this book among those of us who must get our knowledge in simple and accurate terms.

LOVELL DAVIS

A SMALL monograph<sup>1</sup> is presented which records the personal observations of a well known English neurologist upon 117 verified intracranial tumors. The major number of the verifications were made by autopsy. This may be a challenge to those interested in neurological surgery in England. Nothing is added to our present knowledge of facts in the diagnosis of intracranial tumors but a frank record of errors in diagnosis and in steps taken to make a diagnosis are set forth. These are enlightening.

LOVELL DAVIS

OF the increased number of publications on X-ray diagnosis Redding's *Manual*<sup>2</sup> is one of the best that has appeared. It will prove helpful to the X-ray worker who has not the advantage of the great volume of work found in large medical centers. The text is conservative and well written, indicating that the author is exceedingly well versed in the subject. The illustrations of the various lesions described in the text are in the main of excellent quality.

EDW. S. BLAINE

AN elementary handbook adapted more especially for the surgeon who desires to have a working knowledge of roentgenology applicable to his specialty has been prepared by Hans Kurtzahn.<sup>3</sup> He discusses briefly modern apparatus technique, indications for diagnostic use and the findings characteristic of lesions commonly encountered in surgical practice. The part devoted to roentgen therapy is covered particularly well as regards technical considerations but surgical prejudice seems apparent in the discussion of its field of usefulness. Thus the statement is made that radiotherapy with rare exceptions is applicable only in inoperable cases of malignancy. Its usefulness in conditions such as carcinoma of the cervix and uterus is not even mentioned. Its value in glandular tuberculosis, actinomycosis, exophthalmic goiter and various other more or less benign conditions is given due consideration. A short appendix is included giving only the rudiments of the application of radium therapy.

ADOLPH HARTUNG

INTRACRANIAL TUMORS AND SOME ERRORS IN THEIR DIAGNOSIS. Sir James Purves Stewart, B. C. M. G. C. B. M. D. (Edin.) F. R. C. I. N. W. York: Oxford University Press, 1937.

X-RAY DIAGNOSIS A MANUAL FOR SURGEONS, PRACTITIONERS AND STUDENTS. By J. Magnus Redding, F. R. C. S. Senior Surgical Radiologist, Guy's Hospital, London. New York: Wm. Wood and Company, 1937.

CHIRURGISCHE RÖNTGENOLOGIE ZUM GRUNDRISS DER ANWENDUNG DER RÖNTGENSTRAHLEN IN DER CHIRURGIE MIT BESONDERER ANLEHNE AN DIE UNTERSUCHUNG. By Hans Kurtzahn. With a foreword by Prof. Dr. M. Kirschner. Berlin and Vienna: Urban und Schwarzenberg, 1937.

THE ninth volume of the *Bibliothèque du Cancer*<sup>4</sup> edited by Hartmann and Bérard has appeared. The authors have in these 424 pages presented a full discussion of malignant tumors of bone. After a general introduction to the subject, 15 pages are devoted to a discussion of etiology. Their views on the relation of trauma to sarcoma of bone are conservative and are apparently based on the work of Segond.

One hundred and fifty pages are given to the discussion of the pathological anatomy and classification of malignant tumors of bone. They consider 5 general types: osteosarcoma, giant cell tumors, multiple myeloma, endothelioma, and metastatic tumors. Their classification of osteosarcoma is somewhat more involved than that to which American readers are accustomed inasmuch as they classify them first, as to their microscopic appearance into encephaloid, fascicular, osteoid, telangiectatic and cystic sarcoma, second as to their relation to the bone into central and periosteal sarcoma, and third as to their histopathology into spindle and round cell sarcoma. Under the discussion of giant cell tumors of bone a special section is devoted to giant cell tumors of the maxilla.

Following the chapter on pathological anatomy is one on the symptomatology of the different types of malignant tumors of bone. The symptoms of each of the five bone groups are discussed in three divisions. The symptoms of the early stages after full development and in the terminal stages. The authors do not believe that the radiographic signs of sarcoma of bone are specific because as in all other affections of bones there result destruction and alterations of bone substance by the neoplasm and by defense reactions which are found around these lesions. The symptoms of osteosarcoma and of each of the other types are taken up. The discussion of the diagnosis of sarcoma of bone extends through 64 pages. The first section of this chapter is devoted to general considerations. The authors are opposed to biopsy as a means of diagnosis on account of the danger of facilitating the formation of metastases. In the second section of this chapter is a full and clear discussion of the differential diagnosis between bone sarcoma and parosteal tumors, aneurysms, ossifying hematomata, osteomyelitis, syphilitic and tuberculous osteitis, hypertrophic callus, osteitis fibrosa and various benign tumors of bone. This is followed by a discussion of the differential diagnosis of the various types of sarcoma of bone. The final chapter of 69 pages is devoted to treatment.

The volume is illustrated by 48 plates containing from one to four illustrations in black and white. These include gross, microscopic and roentgenological appearances of bone tumors. In many instances the same plate contains the X-ray, gross, and microscopic appearance of the same tumor. The histopathology is shown by means of photomicro-

BIBLIOTHÈQUE DU CANCER. TUMEURS MALIGNES DES OS. By G. Nové-Josserand and L. Taverrier. Paris: Gaston Doin et Cie, 1937.

graphs which on the whole are clear and well selected. On the page facing each plate is a full description with clinical and other details concerning each illustration on that plate.

In the bibliography are the names of the authors arranged alphabetically and the full titles of the articles. References to American literature on tumors of the bone are fairly numerous. The latest reference is to publications in 1925 of which there are three. Relatively slight attention is given to the results of the registry of cases of bone sarcoma formerly under the management of Dr. Codman and now carried on by the American College of Surgeons. The book can be cordially recommended as a clear statement of facts concerning malignant tumors of bone written in a pleasing and easily read French. The typography is excellent, the print being large with wide spaces between the lines.

J. P. SIMONDS

VOLUMES I and II of Deaver's *Anatomy*<sup>1</sup> have been reviewed in earlier numbers of this journal. The present and final volume continues the high standard already established. Its contents include the joints of the lower extremities, the chest, thorax, abdomen, pelvis and perineum. This is probably the most interesting and instructive of the three volumes to the average surgeon. The present arrangement is considerably improved over that formerly used. Both author and publisher deserve the highest praise for the production of so beautiful and authoritative a work; it well deserves to continue as the standard source of information on surgical anatomy.

L. B. A.

TO those who have witnessed the development of the slit lamp by Gullstrand, Henker and Vogt, there can be no doubt but that it has added

much and will add more to our knowledge of ocular pathology. The extravagant claims of the enthusiast will be toned down and the reticence of the doubting will be brushed aside when the balance is finally struck. As the author of the admirable guide to the use of the slit lamp<sup>2</sup> states, the magnification is not so important as the improved illumination for as he admits much that can be seen with the microscope can be made out with the loupe and even the naked eye. With that calm statement of an essential fact one looks farther through Butler's book for much sound advice and is not disappointed except in the discussion of sympathetic ophthalmia. It is impossible to agree with him concerning the part the slit lamp may play in deciding the question of enucleation. If the sympathetic type shares with other types of uveitis the sign of cells in the aqueous retrobulbar space and vitreous, why make their presence the deciding factor in favor of removal of the injured eye? Patients with injured eyes have had a coincident bilateral iritis due to focal infection following trauma to one eye. Why ignore the possibility of coincident focal infection not excluding lues and tuberculosis which give the same symptoms? Shall the possibility of bilateral blindness be determined by the presence or absence of a few cells as seen with a binocular microscope and a well directed beam of light? The older ophthalmic clinicians have not all died as yet and those who have may well arise to help the old guard fight against such teaching.

The book is well printed and consists of 144 pages divided into 16 chapters with a good index and 159 illustrations and 5 color plates. Perhaps those who already know a great deal about the slit lamp will find only confirmation of their ideas in this volume but to the beginner it should be a great help.

V. WESCOTT

<sup>1</sup> SURGICAL ANATOMY OF THE HUMAN BODY. By J. H. B. Deaver, M.D., Sc.D., LL.D., F.A.C.S., d.d. three times, Hon. Physician and Surgeon in Chief, Harvard Medical School, Boston, Mass. Philadelphia: P. Blakiston Co., 1927.

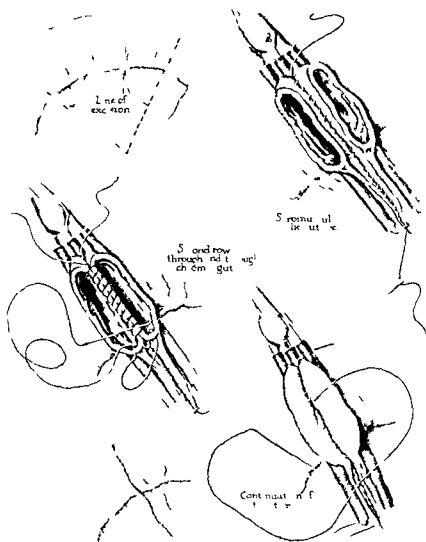
<sup>2</sup> AN ILLUSTRATED GUIDE TO THE SLIT LAMP. By T. HART, M.D., M.A., D.M. (O.), M.R.C.S. (Eng.), L.R.C.P. (Lond.). New York: Oxford University Press, 1927.



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# SURGERY, GYNECOLOGY AND OBSTETRICS

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## SPLENECTOMY<sup>1</sup>

By HERBERT Z. GITTIN, M.D., ROCHESTER, MINNESOTA  
Division of Medicine, Mayo Clinic

THE spleen is the largest lymphoid organ in the body and a reservoir of blood cells. Under exercise and in certain pathological conditions this reservoir extrudes blood into the circulation to maintain circulatory balance. By reason of its anatomical relationships, the balance chiefly affects the portal circulation.

For a long time the ancients believed that the spleen had some relationship to exercise and thought that the wind of runners was improved by removal of the spleen. The basis for their opinion is not known. It was probably influenced by the prevalence of malarial splenomegaly, as this condition would obviously have an influence on exercise. Quite recently, hundreds of years later, Macht and Finesilver found that the speed of rats is increased after splenectomy. The still more recent work of Barcroft and his associates on the volume of the spleen indicates that the contents are expelled into the circulation during exercise. While this does not corroborate the theory of the ancients in its entirety, it does corroborate it so far as it pertains to the existence of some relationship between exercise and splenic function.

### EXPERIMENTAL SPLENECTOMY

No attempt can be made in this paper to review the functions of the spleen, which, together with a complete discussion of the experimental work on the spleen up to 1918,

are given by Pearce Krumhaar, and Frazier. The important effects of experimental splenectomy may be summarized as follows: (1) the occurrence of anemia of the secondary type, (2) the production of leucocytosis, (3) an increase of resistance of the erythrocytes to hypotonic sodium chloride solution and other hemolytic agents, (4) a lessened tendency toward hemoglobinuria and jaundice after the administration of hemolytic agents, (5) a decrease in the volume of the portal blood, (6) the conversion of the bone marrow into red marrow and an actual increase in the volume of the marrow which can hardly be explained as merely compensatory to the anemia following splenectomy, and (7) hypertrophy of the lymphatic tissues which seems to be due principally to hyperplasia of the endothelial cells.

### SPLENECTOMY IN MAN

The anemia noted following experimental splenectomy performed in healthy animals is not ordinarily observed following splenectomy in man for pathological conditions of the spleen, however, mild anemia has occurred as a result of splenectomy for simple tumors of the spleen in otherwise normal persons. Leucocytosis is almost always present following splenectomy in man. A slight increase in the resistance of the erythrocytes or, as in cases of hemolytic jaundice, less marked fragility, has been repeatedly noted. The

<sup>1</sup>Read before the Minnesota Academy of Medicine, March 9, 1927.



jaundice of hæmolytic icterus disappears remarkably after splenectomy and the improvement of the portal circulation probably an evidence of decreased volume of portal blood is demonstrated by the disappearance of ascites and the decreased frequency of gastro intestinal hæmorrhage. Hyperplasia of the lymphatic tissues has been seen occasionally during life and has been definitely found post mortem following splenectomy in man. Also there is a definite increase in the reticulated cell count and in the number of platelets in the circulating blood after splenectomy for various diseases. The increase in the platelets is most marked following splenectomy for hæmorrhagic purpura. From the clinical study of cases it can be said in general that the striking results of splenectomy are (1) improvement in the anæmia both of the secondary type and temporarily even of the primary type (2) a great increase in the number of platelets and a modification of the various factors of coagulation in cases of hæmorrhagic purpura (3) a lessened tendency toward jaundice in general and its disappearance in cases of hæmolytic icterus (4) evidence of improved portal circulation in cases in which cirrhosis of the liver is present and (5) decreased amounts of urobilin and urobilinogen in the duodenal contents and the faeces doubtless the result of absence of the products of hæmolysis in the spleen which before splenectomy were carried in high concentration to the liver.

In 1920 I reviewed a series of cases of splenectomy at the Mayo Clinic especially with respect to operative mortality and post operative duration of life. Since then papers have appeared by W. J. Mayo and Balfour in view of recent experimental and clinical work especially on hepatic function and hæmorrhagic disease which have a bearing on the diseases associated with splenomegaly. It seems wise to summarize our experience again.

The diagnosis and classification of some of the diseases associated with splenomegaly is clear, but of others totally unsatisfactory. Little light has been shed on the differentiation of simple splenomegaly without anæmia splenic anæmia chronic septic splenomegaly, and cirrhosis of the liver. Not infrequently

cases are seen that do not fall satisfactorily into any of these groups and this fact together with the similarity in their pathology seems to indicate that they may have a common etiology. In most instances, it can be argued that this etiology is infectious, probably due directly or indirectly to the ordinary pyogenic organisms although the work of Hollins indicates that it may be due to the bacillus coli.

#### SPLENIC ANÆMIA

The diagnosis of splenic anæmia is obviously unsatisfactory in some cases, it is really based on exclusion eliminating all other conditions which might simulate splenic anæmia as hæmolytic jaundice syphilitic splenomegaly leucæmia in an aleucæmic stage polycythæmia vera after hæmorrhage and so far as possible chronic septic splenomegaly and cirrhosis of the liver. Not infrequently it can not be determined in a given case whether the splenomegaly or the hepatic cirrhosis was primary. Difficulty is also encountered in the differential diagnosis of the cases grouped as splenic anæmia and those grouped as chronic septic splenomegaly especially when an obscure form of sepsis, as primary portal thrombosis is a complication.

One hundred twenty three cases have been classified as splenic anæmia. The number of hospital deaths in this group was 15 (12 per cent). A hospital death means a death occurring while the patient remained in the hospital irrespective of length of stay. This number is not high in consideration of the poor condition of many of the patients the size of the spleen the frequent existence of dense adhesions, and the presence of more or less marked hepatic insufficiency. Operative deaths have been due chiefly to hæmorrhage, pneumonia pulmonary embolism and portal thrombosis. In one instance it was caused by subdiaphragmatic abscess. The average post operative length of life of those who recovered from operation but died subsequently was approximately two and a half years. Of 108 patients who recovered from operation records were obtainable concerning 103, 60 are still living and only 5 of these are in poor condition. Subsequent deaths were due to a

variety of causes among them causes which had no direct relationship to the former condition, as epithelioma of the œsophagus—shock following operation for obstruction carcinoma of the stomach influenza with pneumonia and gangrene of the leg. In fact after ten deaths from apparently unrelated conditions are deducted, the number of subsequent deaths amounts to only 33 over a period of 19 years. The most striking feature in connection with the subsequent deaths is the frequency of postoperative gastric hemorrhage. In twelve instances death seemed to be either directly or indirectly due to gastro intestinal hemorrhage. Fatal hemorrhage occurred as long as 5 years after splenectomy in two cases. Recurrent postoperative hemorrhage is doubtless evidence of advanced cirrhosis of the liver or some other form of portal obstruction. Sixty three patients who were operated on five or more years ago recovered from operation. Of these, 34 were living more than 5 years after operation and 29 are still living and of the group 9 have lived longer than 11 years, one of them 18 years after splenectomy, all in good health except one who has hemiplegia.

The fact that so many patients recovered and have lived so long in good health and that 55 of 60 living patients are in satisfactory condition, justifies splenectomy as a therapeutic measure in splenic anemia. It is likely that the studies of hepatic function that are now being applied to these cases will result in a more accurate estimation of the operative risk and of the probable subsequent prognosis. It may be wise for the surgeon to be content with simple exploration instead of splenectomy in the face of marked retention of dye and the discovery at operation of advanced cirrhosis of the liver. This view is corroborated by the high operative and subsequent mortality in those cases which have been classified as primary cirrhosis of the liver with secondary splenomegaly.

#### CHRONIC SEPTIC SPLENOMEGALY

The cases that have been grouped as chronic septic splenomegaly are those in which splenomegaly has been accompanied by chronic attacks of some form of septic ex-

acerbation over a period of years for example, tonsillitis furunculosis phlebitis primary portal thrombosis ulcerative colitis and ulcerative endocarditis. In such cases the spleen may be markedly enlarged and at the time of examination the features of the case may be characteristic of splenic anemia. A group of 27 cases has been classified as chronic septic splenomegaly and in this group there were 7 hospital deaths and 9 subsequent deaths. The majority of the hospital deaths were due to portal thrombosis. Of the subsequent deaths 5 were due either to cardiac disease or nephritis and 3 to hemorrhage. Only two patients have remained well for a long period after splenectomy, one of them for 10 years and one for 17 years.

It is important to separate this group of cases from the group of splenic anemia because of the high operative mortality in the former and because patients are rarely benefited for a long period by splenectomy.

#### CIRRHOSIS OF THE LIVER

Studies on the pathological changes of the liver have revealed so many bizarre and mixed types of cirrhosis that the clinician can no longer arbitrarily group his cases as portal or biliary. It is hoped that the recent studies on the liver will lead to a new classification. An estimation of hepatic function, if it can be made should be an index of operative risk and subsequent prognosis. The cases I have grouped as cirrhosis of the liver have shown clinically, operatively or pathologically that disease of the liver was primary and splenomegaly secondary. These indications are in some instances not clear. There were 35 cases with 7 hospital deaths. The high operative mortality may be directly due to hepatic insufficiency. Reports on 26 cases are available, of 10 patients living, 9 are now in good or fair condition, but of these the longest postoperative period is only 3 years, and the longest postoperative life in the entire group of 35 cases is 5 years, in the case of a patient now deceased. This is in contrast to 18 years in the case of a patient still living and well in the group of splenic anemia.

The results of splenectomy in cirrhosis of the liver are clearly not satisfactory, and

some new basis for the operation in this group is necessary. Heretofore the size of the spleen has been the chief though not the sole consideration. It should not be concluded however that splenectomy is always contra-indicated in cirrhosis of the liver. It may be decidedly beneficial if hepatic function is not too badly impaired. It is probably most effective in the occasional case of cirrhosis associated with evidence of hæmolytic activity especially in the presence of marked enlargement of the spleen.

#### SYPHILITIC SPLENOMEGALY

The value of splenectomy in cases of syphilis of the liver and spleen when medical treatment had been unsatisfactory was pointed out in earlier papers. The operation doubtless removes a nidus which reinfects the diseased liver. Given an opportunity to heal the syphilitic hepato lobatum is not likely to be deficient in function. The number of cases in this group is 10 with 1 hospital death and 2 subsequent deaths. One patient died 6 weeks after operation from portal thrombosis the other 2 years afterward from pneumonia. All the others are living 4 of them more than 10 years later. All are in excellent health except one who has developed carcinoma of the uterus. Treatment for the syphilis was promptly effective after splenectomy. Better results could not be desired.

#### HÆMOLYTIC JAUNDICE

The importance of the diagnosis of hæmolytic jaundice is now so well understood and the value of splenectomy so generally recognized that it is not necessary to elaborate on them. From the standpoint of diagnosis it may be well to reassert the importance of increased fragility of the erythrocytes in this disease and the necessity of excluding hæmolytic jaundice in every suspected case of splenic anæmia. An occasional case of mild hæmolytic jaundice may show normal fragility, but it is still doubtful whether the erythrocytes in hæmolytic jaundice ever show increased resistance, except when in extreme degree of obstructive jaundice is present secondarily. Cases of cirrhosis with hæmolytic characteristics have been excluded from this group.

In a total of 81 cases the hospital mortality was only 4.93 per cent. Hospital deaths were due to hæmorrhage, peritonitis and uræmia. The number of patients in this group of whom reports are available is 73. Of this number only 7 have died since operation and of the 68 living, 63 are in good health. Most of those who report themselves in only fairly good health show the constitutional debility occasionally seen in patients with hæmolytic jaundice. The subsequent deaths have been due to a variety of causes most of which have been unrelated to the hæmolytic jaundice, such as gangrenous dermatitis, diabetic coma, cerebrospinal meningitis and operation for gall stones. One patient is living 15 years after operation and 13 more than 9 years after operation. Our experience therefore indicates more clearly as time goes on the value of splenectomy in hæmolytic jaundice. The statistics are thoroughly satisfactory.

#### PERNICIOUS ANÆMIA

Between February 10, 1910 and January 1, 1927 a series of 62 patients with pernicious anæmia underwent splenectomy. The last operation was on June 16, 1925. Because of the fact that in recent years only an occasional patient with pernicious anæmia has been submitted to splenectomy, the post-operative records in this group are of greater value. The hospital mortality as would be expected was not high, the hospital deaths numbering 4 (6.4 per cent). Of the entire group 3 are still living 1 year and 8 months, another 3 years and 6 months, and the third 10 years after operation. The total duration of the disease in the last case is 11 years. Approximately 75 per cent of those who recovered from the operation lived less than 3 years afterward with an average total duration of the disease of  $2\frac{1}{2}$  years. It may be significant however, that 25 per cent of those recovering from operation lived more than 3 years with an average total duration of the disease of more than  $7\frac{1}{2}$  years. The patient who is still living after 10 years had all the characteristics of pernicious anæmia including cord changes, the spleen however was large and evidences of hæmolytic were marked.

Nevertheless the case could not be classified as one of hemolytic jaundice. It has been thought that splenectomy is warranted in only an occasional case of pernicious anemia especially if the spleen is enlarged and there are evidences of active hemolysis. It is however not impossible that splenectomy combined with other methods of treatment may eventually have a more significant place in the management of pernicious anemia.

#### MYELOGENOUS LEUCEMIA

In a few cases recorded in the early literature splenectomy was performed for myelogenous leucemia. Practically all of these patients died from hemorrhage and in the light of experience and the nature of the disease it was quite logically concluded that splenectomy was definitely contraindicated for myelogenous leucemia. Following treatment by means of radium and roentgen ray, however, it again seemed justifiable to submit a series of patients to splenectomy. From August 11, 1909, to January 1, 1927, 43 of the cases in which splenectomy was performed were classified as myelogenous leucemia. In all except one of these cases, the operation was undertaken following treatment by radium or roentgen ray or both. In three of the cases, splenomegaly had existed a long time, 6, 9 and 12 years, respectively, and at the time of examination the leucocyte counts were not high. The duration of splenomegaly and the history in these cases suggested that originally they were cases of simple splenomegaly or splenic anemia and that the leucemic process developed shortly before they came under observation. It is also possible that they were cases of a very chronic type of myelogenous leucemia. These three patients who had had indications of the disease for a long time before operation did not fare better after operation than those whose disease had existed for a shorter period, nor did they live any longer. In one case the operation was recent. In the series of 43 cases, there was an operative mortality of three (6.97 per cent). The postoperative deaths were due to peritonitis, mesenteric thrombosis, and hemorrhage with paralytic ileus. It is evident, therefore, that the operative mortality

in cases of myelogenous leucemia after treatment by means of radium and the roentgen ray is lower than the average for splenectomy in general. In many of the early cases of this series the disease was in an advanced stage and the patients lived a relatively short time after operation. It soon became clear that the spleen should not be removed if the patient had had myelogenous leucemia for more than 2 years. In recent years therefore splenectomy has been confined to cases in which the previous history was short, the anemia was not marked and there was no evidence of acute leucemia. In the entire group of 40 patients recovering from operation the duration of life after operation was more than 3 years in 5, more than 4 years in 2, more than 5 years in 2 and 7 years in 1. Twenty patients have lived longer than 2 years, of these 3 are still living. The total duration of the disease pre-operative and post-operative was 4 years or more in 18 cases.

Following splenectomy the patients are in better general health in fact they are frequently able to do all of their former work, they are less anemic and less likely to have recurrence of anemia so common in myelogenous leucemia, the leucocyte count remains quite consistently lower than before operation and when serious recurrence finally does appear the terminal course is rapid. It is the practice in the Clinic to reduce the leucocyte count by means of radium or roentgen ray when it rises above 75,000 or 100,000 following splenectomy. Roentgen ray treatment seems to be more effective following splenectomy than radium application and in an occasional case benzol is more effective than either. It is thus concluded that splenectomy is warranted in certain cases of myelogenous leucemia although it is not to be urged. Patients who apparently have had the disease less than a year, and especially less than 6 months, and who do not show any evidence of acute exacerbations can be promised prolongation of life and better general health with a fair degree of confidence.

#### LYMPHOCYTIC HYPERPLASIA

The cases in which the spleen showed excessive and diffuse lymphocytic hyperplasia

pathologically are included in this group. In 7 cases there were no hospital deaths but 4 subsequent deaths. Three patients died in 3 years or less as would be expected in cases of lymphosarcoma and Hodgkin's disease. One patient however lived 8 years evidently the disease was of the benign type. Two other patients are known to be living 6 and 8 years respectively after splenectomy at the time of operation there was no evidence of lymphatic disease elsewhere in the body and it is possible that splenectomy prevented the development of generalized lymphadenoma.

#### POLYCYTHEMIA VERA

A patient with polycythemia vera underwent splenectomy because of severe recurrent gastrointestinal hemorrhage. He is in good health more than 3 years later and has not required treatment for polycythemia. I do not believe that this single experience justifies splenectomy in polycythemia vera. There is at present no reason to assume that splenectomy in this disease inhibits the production of erythrocytes; however our knowledge of the reactions between spleen and bone marrow is incomplete.

#### HÆMORRHAGIC PURPURA

A report of the early experience in the Mayo Clinic with splenectomy for hæmorrhagic purpura and a general review of the literature up to May 1925 has been published in previous articles. Between March 7, 1923, and January 1, 1927, the spleen was removed in 20 cases classified as hæmorrhagic purpura. The excellent results of this operation are approached only by its results in hæmolytic jaundice and on account of the nature of the disease are much more spectacular. The indications for splenectomy in hæmorrhagic purpura are clear and the most important factor in the decision is an accurate diagnosis. Acute aplastic anemia with hæmorrhagic features, mild hæmophilia in which the coagulation factors are not altogether definite, acute leucemia in which hæmorrhage has developed, and the rare splenomegaly of indeterminate type in which hæmorrhagic features have become superimposed present the chief difficulties in this respect. In

aplastic anemia the anemia usually precedes by a considerable period the development of hæmorrhage, all of the coagulation factors may be those found in hæmorrhagic purpura and persistent and extreme leucopenia together with low reticulated cell count frequently become important factors in the diagnosis.

A diagnosis of acute leucemia depends chiefly on a careful examination of the smears for immature cells; these may be found even though leucopenia is present. It is likely that patients with mild hæmophilia have occasionally been submitted to major surgical operations for other diseases and have recovered after more or less difficulty with postoperative bleeding. It is also likely that mild cases of hæmophilia do not show on examination all of the characteristic coagulation factors of the disease at a given time. There may therefore be difficulty in distinguishing between hæmophilia and hæmorrhagic purpura in certain cases. In fact there is some doubt concerning the diagnosis in two cases recorded in the literature as hæmorrhagic purpura in which splenectomy was performed. In general it should be remembered that in typical cases of hæmophilia the coagulation time is prolonged as estimated on blood drawn directly from the vein with a sharp needle and the platelet count is normal. In hæmorrhagic purpura the platelet level on repeated platelet counts is low, the bleeding time prolonged and the retractility of clot deficient. It has been demonstrated that a palpable or enlarged spleen is not essential in deciding whether to excise the spleen. In several cases reviewed in the literature and in our own series in which splenectomy was performed the spleens were not palpable and in one instance the spleen weighed less than normal. During a period of active hæmorrhage it may be important not to delay operation until the blood count is brought to normal by means of transfusion. Cerebral hæmorrhage seems to be more likely to occur when the blood count has been artificially elevated to too high a level. This was noted at the Clinic prior to the days of splenectomy and a recent case corroborates the observation.

In the 20 cases of splenectomy for hæmorrhagic purpura, there was no operative death. Splenectomy was accomplished with little difficulty from the surgical standpoint, and convalescence was in all instances except one characterized by prompt cessation of bleeding and remarkable improvement in the patient's general health. The exceptional patient, after a stormy convalescence, is now definitely improving one year after splenectomy. Shortly after operation intra-abdominal hæmorrhage occurred, probably from the ovaries, and a secondary abdominal operation was required. Bleeding from the uterus continued but was controlled for a short period, by curettage. Later radium was used in the uterus, and the presence of small uterine fibromyomata was suspected. All excessive bleeding ceased after the treatment with radium, and the patient now seems to be on the road to permanent recovery. Small purpuric and petechial areas continue to appear and the removal of the tonsils as a focus is indicated. This was an extremely severe case and the patient had been in poor health for 15 years. It demonstrates that optimism as to the ultimate result is justifiable even in the face of persistent postoperative hæmorrhage, provided the characteristics are clearly those of hæmorrhagic purpura.

The longest pre-operative duration of the disease was 15 years. The duration was 10 years or longer in 4 cases, 5 years or longer in 7, and 2 years or longer in 13. In only 4 cases did the disease exist less than 1 year before operation. In two it lasted only 2 months. The first patient was operated on 3½ years ago and has been in excellent health since convalescence. Nine patients have been in good health for 2 years or more. Slight epistaxis or petechial and purpuric eruption occurred during convalescence in 4 cases, and uterine bleeding was slightly excessive in 2 and markedly excessive in 1. In one case mild epistaxis and purpura recurred at long intervals for 1½ years after operation. As is now well known, the platelet count rapidly rises after splenectomy, sometimes temporarily to high levels, the bleeding time promptly is reduced, and other adjustments of the factor of coagulation gradually occur. There is a

certain degree of variability in the bleeding time and the retractility of the clot in some cases for an indefinite period. Tonsillectomy in cases of hæmorrhagic purpura has ordinarily been followed by troublesome and even serious hæmorrhage, not infrequently necessitating transfusions, and it would therefore seem advisable to recommend splenectomy previous to the elimination of foci of infection. In view of the slight recurrence of hæmorrhagic symptoms in a few of the cases the elimination of focal infection would seem to be of especial importance. I know of no instance in which the recurrence of petechial and purpuric areas has persisted following a careful elimination of foci.

The significance of the ultraviolet ray and the high vitamin diet in the treatment of thrombocytopenic purpura is not yet established, but they hold out some promise.

#### ACUTE APLASTIC ANÆMIA

Because of the remarkable effect of splenectomy in hæmorrhagic purpura and the contention of some observers that this disease and acute aplastic anæmia are expressions of the same cause, three cases of acute aplastic anæmia were submitted to splenectomy. The operation did not, however, affect the disease favorably. The patients died 1, 2, and 3 months, respectively, after operation. In view of the importance of an accurate differential diagnosis between acute aplastic anæmia and hæmorrhagic purpura, the following case is worthy of brief consideration.

A girl, aged 4, had been well and active until 1 week previous to admission, when purpura and petechiæ appeared. At the time of examination she was quite anæmic. The platelet count was low, the bleeding time prolonged, coagulation time by the Lee method normal, and prothrombin time prolonged. It was recognized that the features of the case were not clearly those of hæmorrhagic purpura, but after a month's observation splenectomy was decided on. The low platelet count and the leucopenia persisted after operation and the bleeding continued. Many transfusions were given. Because of severe infection of the tonsils, tonsillectomy was performed but this did not check the downward

course and the patient died less than 3 months after the onset of the condition

This case might be classified by some observers as a severe fulminating type of hæmorrhagic purpura but a better case can be formulated for a diagnosis of acute aplastic anemia. The fact that severe anemia existed at the time of the first examination despite the short duration of bleeding only 1 week in the absence of free bleeding would lead one to surmise that the patient had been anæmic prior to the development of purpura. It will be noted also that leucopenia was present at the time of the first examination and persisted even after transfusions and after splenectomy and that the platelet count did not rise following splenectomy. These considerations, in view of the rapidly fatal termination favor the diagnosis of acute aplastic anemia.

#### UNUSUAL TYPES OF HÆMORRHAGIC DISEASE

The unusual types of hæmorrhagic disease are perhaps the most instructive and a discussion of them is necessary to a more complete conception of the difficulties and importance of diagnosis. Three cases are briefly reviewed.

The first patient a woman aged 44 had suffered from purpura for 8 years. She complained also of arthritic and muscular pains. There was no history of hæmophilia in the family. The various coagulation tests were normal. The platelet count was somewhat low. At the time of operation moderate enlargement of the spleen was noted. The platelet count rose temporarily and the bleeding ceased following splenectomy. Bleeding however recurred later and has persisted at intervals. The history of arthritis and myositis and the rather marked enlargement of the spleen without the coagulation features of hæmorrhagic purpura aside from a somewhat low platelet level lead to the conclusion that the case is one of chronic infectious splenomegaly with secondary purpura.

The second patient was a woman aged 28. Epistaxis, purpura and enlargement of the spleen began simultaneously 7 years before her admission. Gastrointestinal hæmorrhage occurred later. A detailed study of the case showed a combination of the features of splenic anemia and hæmorrhagic purpura. In favor of the diagnosis of splenic anemia were the markedly enlarged spleen, gastrointestinal hæmorrhage and persistent leucopenia. In favor of the diagnosis of hæmorrhagic purpura were epistaxis, recurrent purpuric areas, low platelet count, delayed retractility of the clot and a somewhat prolonged bleeding time. A year and a half after operation the

patient is reported to be in a satisfactory condition without the recurrence of bleeding.

The third patient, a girl aged 9, gave a history of severe epistaxis since 14 months of age. There was no history of hæmophilia. The patient was extremely anæmic and required transfusions. Neither transfusions by the citrate method or by the direct method nor intramuscular injections of whole blood or the various coagulants were effective in controlling the hæmorrhagic tendency. Before splenectomy the coagulation time (Lee and White method) was normal, the bleeding time was prolonged and retractility of the clot was absent but the platelet level was at all times normal or high. At the time of operation there was a great deal of hæmorrhage from the wound, ecchymosis and petechial hæmorrhagic areas were found within the abdomen and were also caused by handling the viscera. A great deal of local bleeding occurred following operation. The various coagulation tests and the platelet count were not at all affected by splenectomy. The patient continues to have recurrent epistaxis although so far at less frequent intervals than formerly. The case could not be satisfactorily classified as one of hæmophilia, hæmorrhagic purpura or aplastic anemia. Against the diagnosis of hæmophilia are the absence of family history, the normal coagulation time, the absence of involvement of the joints and the fact that the patient had never bled excessively from cuts. Against the diagnosis of hæmorrhagic purpura are the very early onset of the disease at the age of 14 months, a persistently high platelet count, the fact that the platelet count did not rise following splenectomy and the excessive postoperative bleeding from the wound. Again the diagnosis of aplastic anemia are the long duration

TABLE I—SPLENECTOMY MISCELLANEOUS GROUP APRIL 1, 1904 TO JANUARY 1, 1927

Diagnosis	Patient	Deaths			Living
		Hospital	Subsequent	Quoted	
Tuberculosis of the spleen	8*	2	1	4	
Gaucher's disease (longest 18 years and 7 months)	6†	2	1	3	
Ruptured spleen	4	1	0	3	
Wandering spleen (longest 18 years)	2	0	0	2	
Indeterminate hæmorrhagic disease	3	0	0	3	
Acute aplastic anemia	3	0	3	0	
Chronic aplastic anemia	1	0	1	1	
Chronic hemolytic anemia	1	0	0	1	
Acute and subacute septic splenomegaly	2	0	2	0	
Hodgkin's disease	1	0	1	0	
Leishmaniasis with splenomegaly	1	0	1	0	
Neutrophilia with splenomegaly	1	1	0	0	
Hæmorrhagic cysts	2	0	1	1	
Hæmangioma	1	0	1	0	
Secondary splenectomy	1	0	2	5	
Unclassified	3	1	2	0	

\*Two patients died from the disease.

†One patient not bled from the disease.

of the anemia the persistently high leucocyte count, and the high platelet count

Of these three cases the first is probably an instance of chronic septic splenomegaly with secondary purpura. In the second case splenic anemia and hemorrhagic purpura apparently developed simultaneously, and their relationship cannot be determined. In accurate diagnosis cannot be made in the third case, it had all the features of hemorrhagic purpura except the persistently high platelet count.

The remaining cases are shown in Table I. Comment on them will not be attempted in this paper.

#### SUMMARY

This paper is in itself a summary of experience with splenectomy. The most important groups of cases are discussed in some detail. In two diseases hemolytic jaundice and hemorrhagic purpura, the indication for splenectomy depends almost entirely on a satisfactory diagnosis. In all other groups the decision must be reached in each case by a consideration of the factors and circumstances concerned. In general the degree of chronic recurrent sepsis as indicated by the history and clinical data and estimations of hepatic function furnish important indexes for the advisability of splenectomy.



## LARGE SINGLE (NON-PARASITIC) CYSTS OF THE SPLEEN

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CYSTS of the spleen are very rare but as a rule they are readily amenable to surgical treatment. It seems worth while adding the report of one case of this type to the relatively small number already in the literature. The literature is brought up to date in a very recent paper by Frank so that it need not be reviewed here.

## CLASSIFICATION

In a general way three chief varieties of splenic cysts have been described:

1. *Dermoid cysts*. Only two instances of this type are recorded. It is of interest to note that the very first case of splenic cyst reported is said to have been of this type. It was found at autopsy by Andral in 1829.

2. *Parasitic cysts*. These cysts are due to infection by the echinococcus, are not so very rare where infection by this parasite prevails and are commonly associated with similar cysts in other parts of the body.

3. *Non parasitic cysts*. It is this form with which we are concerned in this paper. Up to 1921 Fowler had collected 91 cysts of this variety and of these 65 were classed as large and therefore of definite clinical importance. Since 1921 according to Frank 8 additional cases have been added. Two were reported by Pnibrum 1 by Gambill 1 by Gosselin 2 by Howald and 1 by Frank in the recent paper mentioned. This makes a total of 73 cases raised to 74 by the case herewith reported.

The classification of non parasitic splenic cysts which has been quite generally adopted is that recommended by Fowler in 1921. In his paper of 1924 this author revises his classification somewhat considering the following subdivision a better one:

1. *Traumatic cysts* (a) usually large and unilocular occurring as encysted hæmatoma contents hæmorrhagic or serous (by far the most common variety), and (b) usually small superficial, or deep multiple arising from inclusions of peritoneum (rare).

2. *Inflammatory cysts* (a) tuberculous cysts (Charles H. Peck), and (b) snared off endothelium usually superficially buried in the spleen as the result of perisplenitis (small and multiple) due to malaria leishmaniasis etc.

3. *Degeneration cysts* (solitary and large) arising from secondary changes in infarcted areas due to arterial degeneration or occlusion of blood vessels by emboli with consequent necrosis of the pulp.

4. *Dilatation cysts*. Ectasis of splenic sinuses (polycystic disease Coenen Fowler). These are multiple and fused the cysts usually riddle the organ.

5. *Neoplastic types* (lymphangioma hæmangioma). It may not be possible to distinguish Group 4 which may be borderline in its tendencies from this group. The differential criterion is still obscure.

While this classification is a suggestive one at least until more is known as to the actual etiology of these tumors it does not seem free from objections. Certainly it is better than Fowler's original classification for there was no advantage in the division into the true and false varieties (cysts and pseudocysts). Whatever the etiology may be we have to deal with a tumor mass containing fluid—a true cyst whether the origin be neoplastic or degenerative. The latter often reach a much larger size than do many of the so called true cysts. It would seem wise, therefore to abandon this fictitious distinction. Nor is there any obvious advantage in excluding from the neoplastic group (Group 5) the rare dermoids for certainly these are of definitely neoplastic nature.

With the exception of a group of cases in which the history and the character of the cyst contents points definitely to trauma as the probable cause one can usually only conjecture as to the mechanism of production involved in the individual case. Moreover it is probably true that not a few cases attributable to trauma especially those in which the

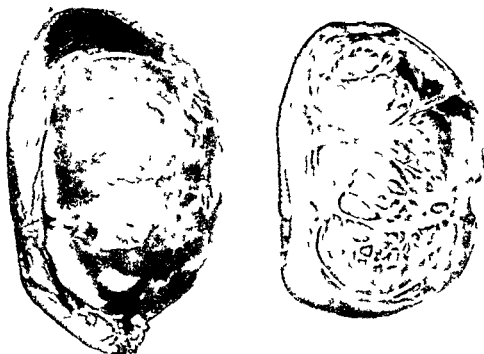


Fig. 1. Gastric surface of tumor mass, most of which is made up of large cysts.  
Fig. 2. Interior of cyst wall, made up of particularly trabeculated fibrous tissue.

contents are serous instead of hemorrhagic are really due to some other cause as yet unknown. The study of the embryology of the spleen may throw further light on the whole question although I have not been able to obtain any clue on this point from the embryologists with whom I have discussed the matter.

Perhaps for the present, until more is known of the etiology of the non parasitic type of cyst, it is best to attempt no subdivision and merely to speak of the entire group as "large single" cysts of the spleen as Pool and Stillman suggest.

#### CLINICAL CLASSIFICATION

Cysts of the type under discussion occur more often in women (about 65 per cent) than in men, and are most common between the ages of 20 and 50. They have been noted however in very young children and even in the newborn infant.

The symptoms are not distinctive. Sometimes the presence of the tumor is the first thing observed by the patient. In most cases when the tumor is of considerable size there is discomfort and perhaps actual pain in the left hypochondriac region. In my case the

pain was intermittent. At times pain is referred also to the left shoulder or the left side of the back. Dyspnea may be complained of together with some digestive disturbance due to the pressure of the tumor upon the stomach.

#### DIAGNOSIS

The location of the tumor will usually suggest the spleen as a possible source as the spleen occupies the left hypochondriac region beneath the left costal margin. The tumor may push in toward the epigastrium or its pedicle may rarely be so long as to allow it to float about in the lower abdomen. In such cases it may even be confused with an ovarian cyst. In my own case as will be noted the position beneath the left costal margin was so characteristic as to suggest the spleen at once and this impression was strengthened by the X-ray picture.

The chief difficulty in diagnosis lies in the differentiation of these cysts from pancreatic cysts. The latter, however usually occupy a lower position, even though they arise from the tail of the pancreas. Other points of differentiation, such as the history and the results of urinalysis, need not be elaborated upon here. Cysts and other tumors of the kidney can



Fig 3 Section of cyst wall showing dense fibrous wall with lining of flattened degenerated epithelium. The splenic tissue appears fairly normal.

usually be readily eliminated by proper urological examination.

#### TREATMENT

The ideal treatment is, of course, splenectomy and this procedure to judge from the published reports is usually possible. In this respect splenic cysts differ from the pancreatic variety which often present far greater technical obstacles to removal necessitating marsupialization. The latter procedure today should be necessary only infrequently though in the earlier days of splenic surgery it was resorted to more frequently. The same statement may be made as to simple incision and drainage and also of aspiration both of which methods have in the past been employed in some cases. Enucleation of the cyst has been done but is rarely possible with any safety to the patient. Certainly it would seem a far more dangerous operation than splenectomy and its justification is therefore questionable when splenectomy is feasible.

#### CASE REPORT

The patient was a married woman of 22 who was referred to me by Dr R. L. Hoyt of Baltimore. Her father had died of cancer of the stomach. Aside from

the usual diseases of childhood the past history did not seem significant. She had had frequent attacks of tonsillitis. No history of malaria or of trauma could be elicited. Menstruation had always been irregular the intervals between periods being usually about 2 months until 4 years ago when the function ceased entirely. She had been married 3 years with out pregnancies.

One year ago she noticed a lump in the left upper quadrant of the abdomen. It was at first painless but as it increased in size it caused some discomfort with occasional sharp attacks of pain radiating to the left shoulder. These usually lasted about 15 minutes and occurred at intervals averaging 2 or 3 weeks. The pain apparently bore no relation to the ingestion of food. More recently when the tumor had become quite large there had been some embarrassment of respiration with a sensation of smothering. There were no gastro intestinal or urinary symptoms.

In August 1926 the patient had an attack of gastro enteritis. In the routine examination made at that time Dr Hoyt noticed the tumor and advised surgical consultation which however was deferred until February 21 1927.

February 27 1927. The general condition of the patient was fairly good although she was quite small and thin with a rather gracile type of figure. The urinalysis was negative. The blood count showed red corpuscles 4,650,000 white cell 8,250 with a hemoglobin of 80 per cent. No abnormalities of red cells were observed.

The abdomen presented a very striking picture. The lower portion was rather scaphoid with thin abdominal wall and good muscle tone. Above the umbilicus however the contour differed on the two sides of the midline. The right side was relatively flat but the left presented a distinct bulging due to the presence of a large mass which projected from beneath the left costal margin downward and inward to about the level of the umbilicus. It was apparently about the size of a child's head and was slightly movable. It was definitely elastic in feel suggesting a cyst. The stomach appeared to be displaced downward and to the right as there was dullness and no tympany over the tumor mass. The mass was situated so far anteriorly that it appeared to be immediately beneath the abdominal wall and it did not extend far back into the flank so that it did not suggest a kidney origin. Furthermore it was at a much higher level than a pancreatic cyst ordinarily is even one arising from the tail of the pancreas. It gave the impression of something pushing downward and to the right from beneath the left side of the diaphragm.

X-ray examination showed the outline of the mass quite distinctly and also a large rather atonic stomach displaced downward and to the right by the mass.

Urological examination revealed no abnormal findings in the left kidney region so that a kidney origin could be eliminated.

*Tentative diagnosis* Cyst of the spleen The menorrhoea was functional

*Operation* A longitudinal left rectus incision was made beginning at the ensiform cartilage and extending below the umbilicus A huge liver colored mass was found occupying the left upper quadrant The stomach was pushed far downward and to the right, but presented no other abnormalities The left lobe of the liver was in contact with the tumor By passing the hand over it, the mass was found to fit snugly against the dome of the diaphragm on the left side Below it was covered with a mass of adherent omentum, with many rather large veins Here appeared however to be no adhesions to the diaphragm so it was decided to attempt removal of the entire mass At first it could not be delivered, but after the incision was lengthened to about 10 or 12 inches the hand could be passed beneath the large upper pole and the whole mass delivered extra abdominally This of course, facilitated the removal a great deal The upper part of the tumor was rounded and presented a grayish yellow area where the cyst wall appeared without any covering of the splenic tissue Over most of the remainder of the tumor there was a thin layer of splenic tissue while at the lower pole there was a triangular mass of normal splenic tissue This lower pole was covered by adherent omentum, but otherwise there were no adhesions The gastrosplenic ligament was carefully secured the pedicle being very securely ligated The splenic vessels were of course of very large size, and were secured with several heavy No. 3 chromic catgut ligatures There was very little bleeding except in tying off the omental adhesions which contained many fragile veins On the whole however, the operation presented no very great difficulty and it was possible to obtain perfect haemostasis After the tumor was removed a split was left which opened up the lesser sac of the peritoneum For fear of intraperitoneal hernia this was securely closed The abdomen was then closed without drainage

The subsequent course was uneventful There was a slight febrile reaction for a few days but the incision healed perfectly Daily blood counts were made, showing no peculiarities except a mild leucocytosis the maximum being 12,200 white cells on the fourth day On the day of discharge 3 weeks after operation the white cell count was 10,500

*Pathological report* The spleen, together with the cyst, formed a mass shaped somewhat like a football though the upper pole was larger and more

rounded than the lower The entire mass measured 28 by 14 by 14 centimeters and weighed 1,754 grams The cyst proper on its external (diaphragmatic) surface was covered by a shell of attenuated splenic substance At the upper pole this covering was absent so that the cyst wall proper presented as a thickened grayish area The lower pole was made up of a triangular peak of splenic tissue The cyst occupied most of the inner or gastric surface of the spleen Along one edge there was a ridge of splenic tissue, with a rather sharp margin (Fig. 1) Beyond this was the rounded cyst mass with its rather thin semitranslucent walls Between the splenic ridge and the cyst, near the lower third of the mass, could be seen the stump of the pedicle (Fig. 1)

The tumor was opened only after hardening The contents of the cyst had evidently been a clear fluid which had undergone coagulation and had become somewhat gelatinous The inner surface of the cyst wall presented a remarkably trabeculated appearance not unlike that seen with some multilocular cysts of the ovary (Fig. 2) There was however, no suggestion of sacculcation the cyst forming one large compartment

*Microscopic examination* The cyst wall is seen to consist of a dense, fibrous and in most places, hyalinized layer of connective tissue Here and there it is covered by a single layer of low cuboidal epithelium but in most places this epithelium is absent presumably from pressure atrophy There is no trace of hemorrhage in the thinner parts of the cyst wall but in the thicker parts a considerable amount of blood is seen between the layers of the cyst wall This suggests that in spite of the negative history, the cyst was probably of traumatic origin

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## PRIMARY STREPTOCOCCUS PERITONITIS IN CHILDREN

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THE earlier writers recorded cases of primary infections of the peritoneum which because of their obscure origin were designated idiopathic spontaneous or rheumatic peritonitis. The condition was thought to be caused by colds and rheumatism. Grawitz, who disagreed with this point of view, exposed animals to sudden changes in temperature in an attempt to produce a peritoneal infection. The condition which we now recognize as streptococcus peritonitis the older writers undoubtedly included in the category of idiopathic peritonitis.

This paper is based upon a study of 14 cases of streptococcus peritonitis—the most serious of acute abdominal lesions occurring in childhood and associated with an extremely high mortality.

Of our 14 patients 9 were females and 5 were males. All were fairly well nourished. Their ages ranged from 3 weeks to 13 years; only two were above 5 years of age. In an analysis (13) of 400 consecutive cases of surgical diseases in children 13 years of age and under streptococcus peritonitis occurred in 1.5 per cent of the cases. In children 5 years and under of this series the incidence was 7 per cent. A seasonal influence was noted as all the cases occurred between October and April except one which occurred during July. This parallels the corresponding seasonal occurrence of upper respiratory tract infections which bear considerable relation to the subject under discussion. The exciting agent was the streptococcus of the hemolytic variety.

The mode of infection has not been definitely established but in searching for a possible focus of infection we could not overlook the frequency of an upper respiratory tract lesion in the majority of cases. In 10 there was present a nasopharyngitis marked in some while in others the acute stage had already subsided at the time of admission. In about one half of these a throat smear revealed the streptococcus to predominate. A pure culture

of streptococcus was unobtainable after the patient entered the hospital because more than one organism was already present. In two of the cases there was a purulent otitis media the exudate of which yielded a pure culture of streptococcus hemolyticus. It is my opinion that the organism entered the circulation at some point in the pharynx possibly through the tonsils and then produced a transient bacteremia with localization in the peritoneal cavity. It is common knowledge that the peritoneum by means of its normal defensive mechanism is capable of destroying innocuous material and a certain dosage of bacteria but the virulence of the streptococcus hemolyticus is ordinarily so great that in children with diminished resistance any protective tendency is easily overcome. Blood cultures were taken in 4 cases and found positive in two. If blood cultures were taken early in the disease and repeated frequently it is likely that the percentage of positive findings would be considerably higher.

In a series of 22 cases of pneumococcus and streptococcus peritonitis reported by Lipshutz and Lowenburg (10) there was a history of a preceding throat infection in 90 per cent of the cases. Rabinowitz (13) cites a similar experience in 8 cases of streptococcus peritonitis. In a severe epidemic of streptococcus sore throat Chapelle (7) has studied 18 cases of streptococcus peritonitis. Hamburger (1) found 12 cases in a Baltimore epidemic. Davi and Rosenow (4) found 4 cases in another epidemic. In several other epidemics of sore throat of lesser severity streptococcus peritonitis is mentioned as a complication. The association of this type of peritonitis with a sore throat appears to be rather common.

In two of the cases of this series the genital tract suggested itself as the portal of entry. There was a marked vulvovaginitis with swelling and redness of the labia and discharge was present. Smears showed a mixed infection with cocci in excess. The avenue of infection

was probably along the vaginal uterus, and fallopian tubes. The presence of an exudate in the tubes at the time of operation supported this view. Armstrong (1) reported 5 cases of peritonitis in female children in two of which it was caused by the streptococcus. He suggested the genital tract as the avenue of entrance. In a study of a large series of cases of primary pneumococcus peritonitis in children McCartney and Fraser (11) found the disease to occur in females exclusively. They have advanced some evidence in support of their view of the genital transmission of the infection.

Streptococci along with other pathogenic organisms, have been recovered from the intestinal tract and in view of this it has been suggested that the organisms pass through the intestinal wall and produce a peritonitis. In only one of our cases was the peritonitis secondary to an inflammatory lesion which was confined to the cecum and was in the nature of a typhilitis. The probable sequence of events in this case was first a pharyngitis followed by septic material invading the blood stream, then a localization in the ileocecal region and ultimately a peritonitis. Streptococci were obtained from the surface of the cecum. A localized purulent peritoneal exudate appeared a few days after the operation, as was evidenced from an enormous discharge through the abdominal incision. Streptococci were obtained from the exudate. Some observers are of the opinion that bacteria will pass through the intestinal wall only if a pathological condition exists. Lennander (9) and others report cases of streptococcus peritonitis in which they found ulcers in the stomach, intestine, and appendix. Jensen (8) who favored the gastro intestinal mode of infection, fed animals with virulent pneumococci but failed to produce a peritonitis except in one animal. Others repeated these experiments without success. In the cases of this series which came to autopsy a search failed to reveal any gastro intestinal lesion.

Transmission of organisms to the peritoneum by way of the lymph stream as has been suggested did not seem justifiable in a single case. In two children, no demonstrable focus could be found to account for the peritoneal infec-

tion. It is possible that a throft infection was present but had escaped the parents' attention.

### SYMPTOMS

The initial phase manifests itself in a nasopharyngitis with a slight cough and a temperature ranging between 100 and 102 degrees F. The parents frequently volunteer the information that all the child has had is a cold. The abdominal symptoms generally appear rather abruptly several days after the onset of the initial phase while the child is apparently recovering from the upper respiratory tract infection. There is a sudden rise in the temperature up to 104 to 106 degrees F. with vomiting which is repeated later in the course of the disease. Older children complain of cramps. Some parents inform us that the child's abdomen was hard implying thereby that some rigidity was present. Diarrhea was notably absent in all but 3 cases. The physical signs are usually slight and in fact entirely out of proportion to the severity of this grave condition. Abdominal pain is elicited early in most of the cases, it is diffuse but more marked in the lower abdomen. Rigidity is absent in the cases seen early. It is present later but is not very marked in most of the cases. Distention was moderate in 5 cases and pronounced in one. It was never troublesome even up to the time of death. The constitutional symptoms are very severe and progressive, indicative of a profound toxemia. The temperature varies between 104 and 106 degrees F. The pulse and respiration are very rapid. The blood shows an average white cell count of 32,000 with an average differential of 90 per cent polymorphonuclears and 10 per cent lymphocytes. The pharynx and tonsils still exhibit signs of a recent infection in the majority of cases, marked in some. Sordes was common. The cervical glands were very much enlarged in one case. In two cases the nervous manifestations were so pronounced as to make it necessary to do a lumbar tap in order to exclude a diagnosis of cerebrospinal disease. In three cases the urine was indicative of renal disturbance.

The disease is rapidly progressive up to the time of death which usually occurs in 1 to 4 days after the operation. Prostration is

marked. Of the three patients that recovered two had a stormy convalescence their stay at the hospital was 6 weeks each. The third the youngest of the three remained at the hospital 26 days her convalescence being uneventful.

#### PATHOLOGY

In the patients operated upon early there was seen a small amount of serous slimy sticky exudate with fibrin flakes covering the intestinal coils in some of the cases. The peritoneum was diffusely injected and in many the seat of small punctate hemorrhages. The intestines were highly injected and moderately distended. In the advanced cases the exudate was considerably increased and seropurulent or fibrinopurulent in character. The coils of intestine were lightly adherent distention was more pronounced but not excessive. In none of the cases was there an attempt at localization noted. The appendix was inspected in every case but one and was found to have its peritoneal coat involved as part of the generalized peritonitis. In four cases it was removed at the time of operation and in 3 of these microscopic examination revealed only a subserous inflammation secondary to the general peritonitis. The other appendix showed an infiltration in all coats with a moderate number of polynuclear leucocytes this was the result of a lesion in the ileocecal region. The mesenteric glands were found enlarged in many of the cases. The peritoneal exudate yielded streptococcus hemolyticus in pure culture in every case but one, in the latter the non hemolytic organism was found.

It cannot be too strongly emphasized that a complete and careful bacteriological examination of the exudate is essential in order to avoid confusion between the streptococcus and pneumococcus peritonitis. On several occasions we considered the lesion at the time of operation to be caused by the pneumococcus until a contrary report by the laboratory was received. Rischbeth (14) reported 54 cases of pneumococcus peritonitis but only half of them were proved bacteriologically. He designated the other cases to be of similar bacterial origin because of the striking resemblance of the exudate to that found in the

other cases which were proved to be of pneumococcus origin. In our series the character of the exudate at the time of operation and subsequently gave insufficient evidence on which to base a bacteriological diagnosis. Ishben (5) has shown from postmortem study of a large series of cases of peritonitis that one cannot determine from the nature of the exudate the type of organism responsible without bacteriological investigation.

The cases which came to autopsy show the lesions described previously in a much more advanced stage. The exudate which now is more fibrinous is spread diffusely throughout the peritoneal cavity under the diaphragm and over the surface of the liver and spleen. The pelvis contains the greater part of this plastic exudate. This finding should not be interpreted as evidence favoring the genital origin of infection in all female children. Even at this late stage there is no attempt at localization of the infection. The internal organs are the seat of a marked purplish mottled degeneration the result of a profound toxemia. The spleen was very soft in two cases indicating the possible existence of a grave blood stream infection. The gastrointestinal tract was carefully examined for any gross lesion which might have permitted the passage of infectious material into the abdominal cavity, but none was found. The mesenteric glands which were moderately enlarged in every case did not suppurate. This latter is a very common postmortem finding in children regardless of the cause of death so no significance was attached to it.

#### DIAGNOSIS

Streptococcus peritonitis presents difficulties which make it almost impossible of accurate clinical recognition. Careful watch of the abdomen is of the utmost importance in a child convalescing from a virus pharyngitis who suddenly has a rise in temperature and develops signs and symptoms suggestive of a peritoneal irritation. Only by bearing in mind that a complication such as streptococcus peritonitis is likely to occur, will one be able to detect the earliest manifestations.

The most frequent condition for which this disease was mistaken was acute appendicitis.

It was thought to exist in the majority of our cases. In appendicitis the onset is not so severe, the temperature much lower, the constitutional symptoms are milder, and the blood count is not so high. The abdominal signs are localized more to the right lower region, rigidity is more pronounced. On rectal examination a tender mass may be palpable.

A clinical differentiation between streptococcus and pneumococcus peritonitis is almost impossible. If a pneumonia or a pneumococcus otitis media or pneumococcus vaginitis exists one may incline toward a diagnosis of pneumococcus peritonitis. In the latter the clinical course is milder, there is a doughy feel to the abdomen, and diarrhoea is present in a large number of cases. Because of the similarity of the clinical manifestations of these two types of peritonitis a differential diagnosis can rarely be made. As stated before even after the abdomen is open no characteristic pathological changes are found which will identify either one without bacterial analysis.

Pneumonia was considered a possible diagnosis in some cases because of the presence of suspicious chest signs in children who had a rise in temperature after an upper respiratory tract infection. This view was strengthened in the absence of abdominal signs necessary for an early diagnosis of streptococcus peritonitis.

Not infrequently, lesions in the chest are the cause of referred abdominal symptoms and such early abdominal manifestations as occurred in this group were interpreted as reflex. Only after the peritoneal phase became more apparent and the X-ray excluded a diagnosis of pneumonia, was our attention focused on the abdominal infection.

In two cases, a lumbar tap was necessary to exclude a diagnosis of cerebrospinal disease.

In spite of points of clinical difference in the above mentioned diseases, clinical variations in symptoms may be insufficient for an accurate diagnosis. The only means at our disposal then for establishing a positive diagnosis prior to operation is a peritoneal puncture. This was employed in 5 of these cases, the exudate which was aspirated was positive for streptococci in every case. The method is very simple and practically free from danger if done with a suitable instrument. In each of the 22 cases

of peritonitis reported by Lipshutz and Lowenburg a puncture was done without any complications. Neuhof and Cohen (12) have employed this diagnostic procedure in over 100 cases of wide variety without any injury to the abdominal viscera. A favorite site for puncture is the midline below the umbilicus and well above the bladder. To avoid injuring the latter it should be empty. The skin and fascia are infiltrated with a few drops of 1 per cent novocain to allow any unnecessary pain. With a bistoury, a punctured wound is made through the skin and fascia to facilitate the entrance of the blunt needle into the peritoneal cavity. The direction of the needle should be toward the pelvis. With a 5 cubic centimeter syringe attached to the needle we aspirate very slowly changing the direction of the needle very carefully if necessary. It is important to remember that in the early stage the exudate is scant and that later on it becomes more fibrous, therefore one should not expect to obtain more than two or three drops of exudate. This amount is sufficient for a direct smear for our immediate information as to the type of organism. A culture should always be made at the same time as in the event of refusal for operation or if the patient expires without surgical intervention a complete bacterial study and classification will have been accomplished.

We do not recommend a peritoneal puncture as a routine procedure but its application is urgently advised as a valuable diagnostic measure in the more obscure cases. Its prognostic value can be appreciated if one remembers that it offers the surgeon the advantage of accurate knowledge of the existing lesion prior to operation and that in the light of such facts he can almost with certainty forecast the outcome.

A pure culture of streptococci obtained from the aspirated pus prior to operation is indicative of a grave lesion and should lead one to give a decidedly grave prognosis. If colon bacilli are obtained, the underlying lesion will most probably be acute appendicitis—a condition of lesser severity and more hopeful outlook. A negative puncture must not be regarded as indicating the absence of a bacterial invasion of the peritoneum, as the exudate



may be so thick or fibrous that it may not pass through the needle

### PROGNOSIS AND TREATMENT

There is still some diversity of opinion as to the management of streptococcus peritonitis. Some advocate early surgical intervention while others in view of the high mortality after operation defer peritoneal drainage until localization takes place. All of our 14 cases were operated upon as soon as the diagnosis was made except in one case. Here a waiting policy was adopted but the child's condition became so desperate that immediate drainage was thought to be the only chance for the child; the outcome was fatal. The average time between the initial infection in the upper respiratory tract and operation was 9 days. Early drainage seems to be the rational therapy since waiting augments the spread of infection without any tendency toward localization. Delay reduces that slight chance for recovery which is favored by early surgical intervention. One is not justified in waiting in a case of streptococcus peritonitis not definitely proved as an acute appendicitis may be overlooked. Supportive treatment should be instituted soon after the patient is seen. Fluids should be forced by every available channel to combat the profound toxæmia. Transfusions are likely to prove of considerable value in some cases.

No other acute abdominal lesion in childhood is attended by such high mortality. Of this series 3 recovered, a mortality of 79 per cent. Other statistics show a mortality between 80 to 100 per cent. There was a higher percentage of recovery among older children.

In our series the three children who survived the infection were 13, 11 and 4 years old. I have found no instance in which a patient with proved streptococcus peritonitis recovered without operation.

### SUMMARY

The occurrence of 14 cases of primary streptococcus peritonitis in a comparatively short period shows it is not a rare disease. In

children 5 years and under it constitutes 7 per cent of all surgical diseases.

In view of the fact that in 10 of these cases there was the initial infection affecting the upper respiratory tract, it is fair to assume that the peritoneal infection came by way of the blood stream. Vulvovaginitis by direct extension along the genital tract, was responsible in two cases. Other modes of infection did not suggest themselves in this series.

The symptoms were those of peritoneal irritation, namely, pain, vomiting, abdominal tenderness and rigidity, together with high temperature, high white cell count, and prostration.

An early exact diagnosis is difficult because the symptoms and signs are often slight and not significant of the disease.

Acute appendicitis is most often confused with streptococcus peritonitis and the only positive method for a correct diagnosis is a peritoneal puncture.

The treatment is surgical as soon as the diagnosis is established, supportive therapy must be instituted early. The prognosis is very high, 79 per cent in our series, older children are favored with a slightly better chance for recovery.

For the courtesy of permission to report these cases I am indebted to Drs. Henry Roth and L. Miller Kahn. I also wish to thank Drs. Milton Bookman and Louis Sheinman for the privilege of including two private cases.

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## ACUTE SURGICAL DISEASES OF THE ABDOMEN IN CHILDREN

A STUDY OF FOUR HUNDRED CASES<sup>1</sup>BY MORRIS COHEN, B.S., M.D., NEW YORK  
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THE patients we see in our daily practice leave impressions that may be transient or lasting and the sum total of these impressions constitutes our experience which is the basis of the opinions we hold concerning the various diseases we encounter. Perhaps a careful study of one's experience in a particular field of surgical practice may result in the breaking down of some views, in the reinforcement of others, or perhaps in the creation of entirely new opinions. It is with this thought in mind that I have attempted to review the subject of acute abdominal diseases in children basing this study upon personal observations made primarily in the wards and operating rooms of Lebanon Hospital and upon the records of 400 patients admitted consecutively to Lebanon Hospital over a period of 4½ years beginning January 1, 1922.

In this discussion the term child refers to a patient who is 13 years of age or under. "Acute abdominal disease" refers to any acute disturbance in a child's abdomen which is not the result of trauma and which requires surgical treatment.

## GENERAL CONSIDERATIONS

When we read the list of pathological conditions encountered we find that they can be classified into two large groups. The first and by far the larger of the two, includes all those pathological conditions that are primarily inflammatory in character, and the second group includes all those conditions the pathology of which is due to some mechanical derangement of normal relations.

Examination of the records of the patients in the first group reveals that out of 367 patients who at the time of admission to the hospital were apparently suffering from some acute, inflammatory intra abdominal disease, 354 were admitted with the diagnosis of acute appendicitis. In one of the latter number,

typhoid fever was the admission diagnosis, but this was changed to acute appendicitis after the patient had been in the hospital one day. All of these 354 children were not subjected to operation. Out of 327 children operated upon for acute appendicitis, varying degrees of inflammatory change of the appendix were found in 312. Operation or subsequent findings revealed the following conditions in the remaining 15 children: pyelitis in 3, mesenteric lymphadenitis in 6, and in 1 of these the tip of the appendix was buried in a suppurating mesenteric node, primary acute diffuse peritonitis in 3, torsion of an ovarian cyst pedicle in 1, and torsion of the omentum in another. The last two conditions wrongly diagnosed as acute appendicitis can be properly included in the group of cases discussed as mechanical derangements. One child, whose peritoneal cavity contained a large quantity of serous fluid which proved to be sterile, was released from the hospital one week after operation while he was still running an irregular, febrile temperature. The diagnosis in this instance was not determined.

The 27 children who were not operated on were discharged from the hospital cured or improved. The final diagnoses for these patients were gastro enteritis, colitis, and constipation in 7, pyelitis in 2, chronic appendicitis in 6, acute salpingitis in 1, ascariis lumbicoides in 1, nasopharyngitis in 1, influenza in 1, and undiagnosed, 8.

The remaining diseases in the inflammatory group were as follows: primary peritonitis due to the streptococcus or pneumococcus occurred in 10 children 3 of whom were operated upon for acute appendicitis, while acute cholecystitis, nephrolithiasis, secondary abscess after appendectomy, perineal abscess and liver abscess were represented by one patient each. One child, a boy of twelve who showed signs of diffuse peritonitis died immediately after admission to the hospital and the

<sup>1</sup> From the Surgical Services of Lebanon Hospital. Read before the Bronx County Surgical Society, February 23, 1927.

TABLE I—ANALYSIS OF FOUR HUNDRED CASES STUDIED

I Patients admitted for acute inflammatory intra abdominal conditions	367
A Admitted with diagnosis of acute appendicitis	354
Operated upon for acute appendicitis	327
Appendicitis found in	312
Other conditions found	
Pyelitis	3
Lymphadenitis	6
Primary peritonitis	3
Twisted ovarian cyst pedicle	1
Torsion of omentum	1
Undiagnosed	1
Not operated upon	21
Gastro-enteritis colitis constipation	
Pyelitis	2
Chronic appendicitis	6
Acute salpingitis	1
Ascariis lumbricoides in intestines	1
Nasopharyngitis	1
Influenza	1
Undiagnosed	8
B Miscellaneous	13
Primary peritonitis	
Perirenal abscess	1
Subphrenic and liver abscess	1
Acute cholecystitis	1
Nephrolithiasis	1
Secondary peritoneal abscess	1
Peritonitis (died on admission)	1
II Patients with mechanical derangement	35
A Intestinal obstruction	33
Intussusception	22
Incarcerated hernias	
Miscellaneous	4
Atresia of the colon	1
Volvulus of sigmoid	1
Obstruction due to band	1
Obstruction (transient)	1
B Miscellaneous	2
Torsion of ovarian cyst pedicle	1
Torsion of omentum	1
Included in diagnosis	11

cause of the peritonitis was therefore not determined although it was undoubtedly of appendicular origin

## ACUTE APPENDICITIS

*Age distribution and etiology.* As acute appendicitis is represented by the largest number of patients a detailed study of this condition will be made. Among 312 patients in whom appendicitis was found 194 were boys and 118 were girls. The youngest child was 1 year old and was the only patient at that age. The greatest number of cases for any single year occurred at age 10 (Table II). As age increases the frequency with which appendicitis occurs also increases. That

TABLE II—CASES OF ACUTE APPENDICITIS ACCORDING TO AGE

Age in years	Number of cases	Age in years	Number of cases
1	1	8	32
2	8	9	27
3	18	10	43
4	15	11	30
5	17	12	42
6	19	13	
7	9	Total	312

TABLE III—CASES OF ACUTE APPENDICITIS ACCORDING TO SEX

Sex	Number of cases
Male	194
Female	118
Total	312

acute appendicitis is not an uncommon ailment in the very young is proved by the presence of 59 cases in children 5 years of age or under. To explain the increasing incidence of the disease as the child grows older is a matter of speculation. Fraser's explanation based on anatomical and bacteriological principles is deserving of consideration.<sup>1</sup> He suggests that the increasing amount of lymphoid tissue in the appendix as the child grows older renders that organ more susceptible to infection by the bacillus coli which is most frequently found in acute appendicitis. The toxicity of the bacillus coli is enhanced by a varied diet and occasional attacks of gastroenteritis. Other causes at all ages are foreign bodies the most frequent one being the fecolith and in one instance pinworms. Kinks and twists of the appendix, constipation and intestinal infections from carious teeth, tonsillitis and infections of the upper respiratory tract. In 86 per cent of the cases in this series there was a coincident tonsillitis or nasopharyngitis. In addition to these, two children had just recovered from scarlet fever, two had pneumonia, one measles and one whooping cough.

*Pathology.* Microscopic examination of the appendices shows that the infection begins in the mucous coat then involves the submucous lymphoid tissue and from there travel outward through the muscular layer to the peritoneum. Where there is destruction of tissue this disintegration begins in the mucous

ling of the appendix and the process progresses slowly or rapidly to localized or general gangrene and perforation, with the complicating abscess or peritonitis. The thinness of the appendicular wall and the large amount of lymphoid tissue explain perhaps the rapid and virulent course that appendicitis takes so often in the very young. The bacillus coli as already stated above, was the infecting organism most frequently isolated.

**Symptoms.** The classical syndrome of abdominal pain which localizes in the right lower quadrant and which is followed by vomiting predominated in this series. Seventy-five per cent of the patients gave such a history. In 15 per cent there was no vomiting, in 6 per cent vomiting preceded the pain and in the remaining cases there was no record of vomiting. A few patients complained of pain in the right upper or left lower quadrant. Most children were constipated or had regular bowel movements. Diarrhea was exceptional. Convulsions occurred in two children and chills were unusual. In one child who died progressive jaundice was an outstanding symptom and indicated a virulent infection with an early complicating pylephlebitis. Although every rule has its exceptions, and this is well illustrated here, I cannot emphasize too strongly in the diagnosis of acute appendicitis in children the importance of adhering closely to the classical group of symptoms—abdominal pain which localizes in the right lower quadrant and vomiting. When there is any deviation from the usual sequence of these symptoms, one should look for unquestionable physical signs for only positive evidence should lead us to operate for acute appendicitis.

**Physical signs.** Tenderness and rigidity of varying degree in the right lower quadrant were the outstanding physical signs. In some instances where a localized abscess was found, a mass could be felt in the right lower quadrant and in isolated instances a mass could be felt by rectal examination. Tenderness to the left of the midline was noted in a few patients and in these the tip of the inflamed appendix was found on that side. In two children in whom the tenderness and rigidity seemed to be most marked in the right upper quadrant of the abdomen, the tip of the inflamed appen-

dix was found in contact with the lower pole of the right kidney in one and high up under the liver in the other.

**Temperature, pulse and respiration.** The degree of elevation of temperature was not found to be always consistent with the amount of pathological change found. Fever varied from a rise of less than one degree in some instances to one of five or six degrees in others. A few children had a normal temperature when admitted to the hospital. However in most of these children the temperature on admission varied between 100 degrees F. to 102 degrees F.

The pulse rate usually varied from 100 to 120 per minute. When the pulse rate was very rapid there was a local or spreading peritonitis.

Respirations were not increased to any appreciable degree. When the respirations are markedly rapid, the chest should be carefully examined for signs of pneumonia. On several occasions I have seen children with symptoms of acute appendicitis, in whom physical examination revealed the presence of a developing pneumonia.

**Blood count.** In these cases of acute appendicitis we found an increase in the total number of leucocytes, the average number found in uncomplicated cases being 14,000 per cubic millimeter, and a relative increase in the polymorphonuclear leucocytes, the average percentage being 80. When peritonitis had ensued, both total number of leucocytes and percentage of polymorphonuclear cells were much higher. Deviations from this rule and the presence of an increased white cell count in so many other conditions have caused me not to look upon the blood count as deciding evidence for a diagnosis of acute appendicitis.

**Urine examination.** The results of the chemical and microscopic examinations of the urine in these patients at the time of admission to the hospital warrant the conclusion that in acute appendicitis the urine remains unchanged. Three children who were operated upon for acute appendicitis and whose urine showed albumin and clumps of pus cells were actually suffering from acute pyelitis. Two other patients admitted to the hospital for acute appendicitis were not operated upon.

because examination of specimens of their urine revealed similar findings and a diagnosis of acute pyelitis was made in each case. These five children recovered after proper medical treatment was instituted.

Evaluating the factors that determine the diagnosis of acute appendicitis in a child history and abdominal physical signs are the most important. Nothing taxes the patience of the physician more than the eliciting of these physical signs in a child. This applies particularly to the very young. The abdomen of the crying child is held rigid voluntarily, yet if the examining hand is applied lightly and held in position persistently there will be intervals when this voluntary spasm disappears and the relaxed abdominal wall of the normal abdomen is felt or when localized rigidity is present relatively softer areas in other parts of the abdomen become apparent. I have noticed general abdominal rigidity in young children when there was only an uncomplicated acute appendicitis. The eliciting of tenderness presents similar difficulties. An increase in the intensity of the child's cry while the abdomen is being palpated is usually indicative of tenderness and as Dr. Henry Roth has demonstrated a persistent attempt on the part of the child to push away the examiner's hand a protective mechanism is usually indicative of an intra-abdominal inflammatory condition, however when the child does not object to the examining hand we can safely assume the absence of an acute inflammatory condition.

*Factors influencing course of appendicitis.* The ultimate outcome of acute appendicitis in a child is definitely influenced by age, duration of illness prior to operation, the administration of cathartics and by the occurrence of previous attacks.

*Effect of age.* That in children in the first 4 years of life acute appendicitis runs a rapid and frequently fatal course is evidenced by the fact that among 42 children 4 years of age and under there were 8 deaths a mortality of 19 per cent, while for the entire group there were 13 deaths a mortality of only 4 per cent.

*Effect of duration of illness.* Drainage of the abdominal cavity was instituted whenever the appendix was perforated or when there

was a complicating abscess or peritonitis. Examination of Table IV shows that as the duration of illness prior to operation increases there is a definite increase in the number of cases that had to be drained. Drainage was

TABLE IV.—EFFECT OF DURATION OF ILLNESS ON COURSE OF ACUTE APPENDICITIS

Duration in days	Case	Drained	Per cent drained
1	149	73	48
2	77	49	63
3	30	20	66
4	20	12	60
5	6	4	66
6	9	7	77
7	7	6	85
8 or more	12	7	58
No record	2	1	50
Total	312	199	57

employed in 48 per cent of the patients who were ill only one day while it was used in 83 per cent of those children who were sick 7 days. There is a drop in the percentage of cases drained when illness lasted for a period longer than one week. In these few children the inflammatory process was subsiding at the time of operation.

*Effect of catharsis.* Table V shows the effect of catharsis upon the course of acute appendicitis in children. Out of 64 patients who received catharsis before operation 71 per cent were drained while out of 38 children who did not receive such treatment only 42 per cent were drained. That catharsis during an attack of acute appendicitis has a deleterious effect upon the course of the disease seems to be established.

*Effect of previous attacks.* Table VI shows that children who have had one or more previous attacks of acute appendicitis seem to have a milder form of the disease in subsequent attacks. Out of 63 patients who have had earlier attacks of acute appendicitis only 49 per cent were drained while out of 140 who did not have any such previous illness 61 per cent were drained. These unexpected figures are readily explained by the fact that in these patients fibrosis of the appendix and adhesions limit the extension of the inflammatory process or by what seems more likely that parents send their children to the hospital much earlier in subsequent attacks of acute

TABLE V—EFFECT OF CATHARSIS PRIOR TO OPERATION ON COURSE OF ACUTE APPENDICITIS

Catharsis	Cases		Per cent drained
	Drained	Not drained	
Yes	64	46	71
No	38	16	42
No record	210	117	55
Total	312	179	57

TABLE VI—EFFECT OF PREVIOUS ATTACKS ON COURSE OF ACUTE APPENDICITIS

Previous attacks	Cases		Per cent drained
	Drained	Not drained	
Yes	64	32	40
No	140	86	61
No record	107	61	57
Total	312	179	57

TABLE VII—DEATHS FROM ACUTE APPENDICITIS ACCORDING TO AGE

Age in years	Cases	Deaths	Per cent mortality
1	1		
2	8	5	62.5
3	18	2	11.1
4	15	1	6.6
5	17		
6	10		
7	28		
8	32		
9	27	1	3.7
10	43	1	2.3
11	30	3	10.0
12	42		
13	32		
Total	312	13	4.1

TABLE VIII—DEATHS FROM ACUTE APPENDICITIS ACCORDING TO DURATION OF ILLNESS PRIOR TO OPERATION

Duration of illness in days	Cases	Deaths	Per cent mortality
1	149	1	0.6
2	77	3	2.5
3	30	1	3.3
4	20		
5	6	1	16.6
6	9	4	44.4
7	7	2	28.5
8 or more	12	1	8.3
No record	2		
Total	312	13	4.1

appendicitis. Out of 65 children who have had previous attacks of acute appendicitis 62 per cent came to operation during the first day of illness, while out of the 140 children who were having their first attack of acute appendicitis only 50 per cent were operated upon during the first day of illness.

*Deaths from acute appendicitis.* In this series of 312 cases of acute appendicitis there were 13 deaths, a mortality of 4 per cent. Two of these children had pneumonia when admitted to the hospital, another child had a severe form of chronic cardiovascular disease, one child when admitted had a nasopharyngitis bilateral otitis media and stomatitis while still another had a fulminating type of acute appendicitis in which there was a complicating pyelophlebitis before operation. The greatest mortality for any single age occurred at age 2 when 5 out of 8 children died giving a mortality of 62 per cent. The children at age 3 had a mortality of 11 per cent and those at age 11 a mortality of 10 per cent. As already stated the mortality among the patients 4 years of age and under was 19 per cent, while for the entire group of 312 patients it was only 4 per cent. This percentage would have been much lower had there not been other serious complicating diseases in 5 of the children who died. The danger of postponing operation is well illustrated by these 13 deaths, 5 of which were of children who had been ill from 1 to 3 days while 8 were of children who had been sick from 5 days to more than a week.

This analysis of a group of 312 cases of acute appendicitis in children shows that this condition is the most frequent abdominal disease in children requiring surgical treatment, that younger children are more likely to have a serious form of the disease, that delaying operation means inviting complications and death, that catharsis is undoubtedly a cause of complications in many patients, that previous attacks of acute appendicitis for reasons explained above do not predispose the patients to serious complications in the attacks for which they are operated upon, that blood count, temperature, pulse, and respirations are of secondary importance in the diagnosis of this disease, that urinary findings are negative in most cases of acute appendicitis, that history and abdominal physical signs should be the guiding factors in arriving at a diagnosis, and what is very important that patience on the part of the examiner is an important attribute when studying a child who has symptoms of acute abdominal disease.

*Differential diagnosis of acute appendicitis*  
In the differential diagnosis of acute appendicitis, it appears from a study of the diseases found in this series that mesenteric lymphadenitis and acute pyelitis are the only conditions wrongly diagnosed as acute appendicitis that need more lengthy discussion than mere mention of their names.

*Mesenteric lymphadenitis* The symptoms and physical signs of mesenteric lymphadenitis are so often like those of acute appendicitis that a correct diagnosis is rarely made. Abdominal examination usually does not reveal any palpable nodes. If these children come to operation because of a diagnosis of acute appendicitis the enlarged lymph nodes usually found in the ileocaecal region should be left alone unless suppuration has occurred. There may be enlarged nodes in other parts of the abdomen. These children generally recover completely without any other treatment except the employment of general hygienic measures. Although inflamed mesenteric nodes accompany the inflammatory intestinal diseases and are found as part of glandular fever in children they are most often due to a primary tuberculosis of the mesenteric lymph nodes and should be treated accordingly.

*Pyelitis* Five children four of whom were girls had pyelitis and they were all admitted with the diagnosis of acute appendicitis. They were 5 years of age and older. The symptoms of acute pyelitis vary in intensity and at times are so slight that a correct diagnosis can be made only after urine examination. In the older children as found in this group, there may be local symptoms in addition to the general constitutional symptoms and the former may predominate. The local symptoms often experienced are abdominal pain, pain in the flank, and painful micturition. When these are accompanied by tenderness and rigidity on the right side of the abdomen a diagnosis of acute appendicitis is often made. Urinary findings determine the correct diagnosis. In this series none of the children with acute appendicitis had clumps of pus cells in the urine. Such findings especially in a female child admitted to the hospital for acute appendicitis should warrant the withholding of surgical interference

until the correct diagnosis is definitely established.

#### PRIMARY PERITONITIS

There remains to be considered among the inflammatory diseases the cases of primary peritonitis which are a source of great concern to the surgeon. The 10 cases in this group consisted of 5 that were caused by the streptococcus haemolyticus, one by the streptococcus non haemolyticus 3 by the pneumococci, and one in which the causative organism was not determined. Five of the 6 children who were suffering from streptococcus peritonitis were 5 years old or younger and 1 the only one to survive was 13 years old. Four were girls and 2 were boys, and in one of the former the fallopian tubes were discharging pus. All of these children had infections of the respiratory tract prior to the onset of abdominal symptoms. One child had abdominal symptoms for a week prior to operation while in the remaining 5 the duration of symptoms was not longer than 2 days.

One child a girl of 8, in whom the infecting organism was not determined, recovered.

All of the children with pneumococcus peritonitis were girls 2 of whom were 6 years old and 1 was 4 years old. The duration of abdominal symptoms in all of these children was one day and only one patient gave a history of a preceding respiratory tract infection. In this child the right fallopian tube was found to be oedematous. The mortality for pneumococcus peritonitis was 100 per cent.

Primary peritonitis does not present so much a problem of diagnosis as of treatment. All of the patients in this group were operated upon and 8 of 10 died. Some workers have advised waiting until the peritonitis localizes others operating immediately after the diagnosis is made. It seems that the 6 children have a very high mortality no matter what course is taken. However as we are never certain that acute appendicitis is not the cause of an existing peritonitis a rapid diagnostic laparotomy is always indicated.

#### MECHANICAL DERANGEMENTS

In the group of patients whose symptoms were due to mechanical disturbances there

were 35, and among these are included the two children whose conditions were wrongly diagnosed as acute appendicitis but who were found to be suffering from torsion of the omentum and torsion of an ovarian cyst pedicle respectively. In the light of the operative findings in the first of these patients it is seen that the abdominal physical signs tenderness at and to the left of the umbilicus were suggestive of the pathological condition found. As for torsion of uterine adnexa in children I have shown in an earlier paper that when signs and symptoms pointed to a lesion in the lower abdomen particularly on the right side there was a tendency to diagnose the condition as appendicitis.<sup>1</sup> Twenty two of the children had acute intussusception seven incarcerated hernias, two had intestinal obstruction produced by congenital anomalies of the gastro intestinal tract one boy of 13 was found to have intestinal obstruction produced by a band that bound down the distal end of the ileum, and one child who had been operated upon 7 months previously came in with a transient attack of intestinal obstruction that disappeared spontaneously. The diagnosis of incarcerated hernia was not difficult to make for in all of the children who had this condition there was the history that the child had had a reducible hernia that suddenly became painful and irreducible. The presence of a tender irreducible mass in the inguinal region confirmed the diagnosis. Two children both females began to show signs of intestinal obstruction soon after birth and at the time of operation they were 2 and 4 days old respectively. The younger child had a volvulus of the sigmoid produced by a cyst that was suspended from the sigmoid by a long pedicle. This pedicle was not alone twisted but it was wound round a loop of the sigmoid. The other infant had an atresia of the large intestine. Intestinal obstruction in newborn infants is in most instances due to a congenital anomaly of the gastro intestinal tract.

#### INTUSSUSCEPTION

Of all the forms of intestinal obstruction studied in this series of cases, acute intussus-

ception occurred most frequently. This disease was found in 22 patients of whom 15 were boys and 7 were girls. The ages varied from 4 months to 30 months the largest number of patients being found at 7 months. Only 5 of these children were older than 1 year. The duration of illness prior to admission to the hospital varied from 1 hour to 7 days. Ten of the children were admitted within 12 hours after the onset of symptoms and 15 were admitted within 24 hours.

*Symptoms.* The classical group of symptoms in acute intussusception consists of abdominal pain which is sudden in onset and rhythmic in character, shock which is usually described by the mother as marked pallor, vomiting and blood stained mucus on the diaper. All of these symptoms need not be present to establish a diagnosis. Abdominal pain was reported as occurring in 17 patients, vomiting in 18, bloody mucus in 19, and sudden pallor in 10. In six histories no mention was made of shock and the occurrence of this symptom is undoubtedly much more frequent. The guiding symptoms in this disease are rhythmic abdominal pain, varying degrees of shock and blood stained mucus passed by rectum all occurring suddenly in a child previously in good health. Vomiting may not be an early symptom and although constipation is characteristic there may be one or more stools. One child, 20 months old who had an umbilical hernia and was ill for 7 days with symptoms of abdominal pain, vomiting and diarrhoea and who showed bloody mucus in the stools was admitted for reduction of an incarcerated umbilical hernia. Laparotomy revealed adherent omentum at the umbilicus and an ileocolic intussusception.

*Physical signs.* The usual appearance of the little patient with acute intussusception is that of a child, generally a boy under 1 year, pale and at times markedly so who may be lying quietly, but at intervals will cry out as if in pain and draw up his little legs. The abdomen is distended and on palpation one can feel a sausage shaped mass along the colon most often in the region of the transverse or descending portions. Visible peristalsis may be noted. Even so short a time as 1 hour after the onset of symptoms, but usually sev-



eral hours later bloody mucus is seen on the diaper or the examining finger. Tenesmus is seen only in those cases of long duration and was not noted in any of the records of the patients in this group. A boggy mass in the rectum the apex of the intussusception is not felt early in the disease. Rigidity and tenderness may be present. Enemas are ineffectual although at times the first returns may contain fecal material. In this group of 22 patients an abdominal mass was palpated in 17. One child who had two distinct masses one along the ascending colon and another in the region of the splenic flexure had two intussusceptions one of which was ileocaecal and the other ileo ileal. Rectal masses were palpated in only two of the patients.

*Varieties of intussusception.* Most of the intussusceptions in this series were of the ileocaecal variety. In one child a retrograde intussusception of the sigmoid extending to the transverse colon was found another had an intussusception of a Meckel's diverticulum extending through ileum and cecum and another child had two intussusceptions as already noted.

*Deaths from intussusception.* There were 5 deaths among 19 children who were operated upon. In one child the intussusception was reduced spontaneously before the child reached the hospital and 2 were cured by enemas. All deaths occurred in children who were sick 24 hours or longer. One child who died had a complicating pneumonia at the time of admission and developed a volvulus of the intestine as a postoperative complication. One of the children that died was ill for 5 days. The fact that 3 out of 22 children were cured without operation should not encourage the use of non operative methods. To save the lives of these children the diagnosis must be made early and surgical treatment must be instituted as soon as the diagnosis is made.

## CONCLUSIONS

In a series of 400 patients all children 13 years of age and under, admitted to Lebanon Hospital for operation for acute abdominal diseases, there were two classes of patients those suffering from inflammatory diseases and those suffering from diseases due to mechanical disturbances.

Acute appendicitis is represented by the greatest number of cases in the first group and it has been demonstrated that age duration of illness prior to operation and the administration of cathartics have a harmful effect on the course of the disease while previous attacks of acute appendicitis contrary to general belief do not seem to have an unfavorable effect on subsequent attacks.

Mesenteric lymphadenitis and pyelitis are often differentiated with difficulty from acute appendicitis. In pyelitis however urinary findings determine the diagnosis.

Primary peritonitis although represented by only 10 patients is important because of its usually fatal course. All patients suffering from this condition should be given the benefit of early operation as we are never certain that appendicitis is not the cause.

Acute intestinal obstruction is the most frequent abdominal disease in the group of mechanical derangements. Acute intussusception is the most frequent form of obstruction found and next in order is obstruction due to incarcerated inguinal hernia. Intestinal obstruction in the newborn is always due to a congenital anomaly of the gastrointestinal tract. Early diagnosis and early operation in acute intussusception are life saving measures. One should not wait for all the classical symptoms and signs to determine diagnosis and treatment in this disease.

I am greatly indebted to all the members of the surgical staffs at Lebanon Hospital for permission to use record of their patients.

## HEXYLRESORCINOL AS A GENERAL ANTISEPTIC

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## THE QUALIFICATIONS ESSENTIAL TO AN EFFECTIVE TISSUE SURFACE DISINFECTANT

THE disinfection of tissue surfaces, such as skin, mucous membranes, denuded areas, wounds, etc., presents one of the most fundamental problems in surgery. In the course of various investigations with new antiseptic substances carried out in this laboratory during the past few years, certain conclusions have been drawn regarding the failure of most germicides in tissue surface disinfection, from which have been evolved a series of qualifications regarded as essential to an effective general antiseptic intended for use in this field. Such a substance should be (1) chemically stable, (2) non-toxic, (3) non-irritating, (4) rapidly bactericidal in high dilutions, (5) highly penetrating, (6) unaffected by organic matter. Freedom from stain and objectionable odor may be noted as highly desirable properties although they are not essential.

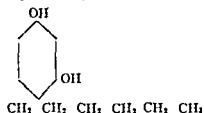
The interest attaching to a study of the alkyl resorcinols as internal antiseptics, since one of the writers originally described the biological properties of this series (12, 13), has delayed an investigation of their possible application as general antiseptics, a field which would ordinarily have been investigated first. This group of compounds, comprising the most powerful phenolic germicides known, has now been thoroughly studied. Certain information of fundamental importance bearing on the relationship of chemical constitution to bactericidal activity and the role of certain physical properties of germicidal solutions in largely determining their efficiency in surface disinfection, has been gathered in the course of this work and will be discussed briefly in so far as it relates to the subject.

## ALKYL RESORCINOLS

As a rule, increased toxicity and irritant properties go hand in hand with increased

germicidal power. As a group, the alkyl resorcinols exhibit a combination of properties which is entirely unique in that the enormous increase in germicidal power which accompanies each increase in the number of carbon atoms in the alkyl chain, from 3 to 4, 5, and 6 (Fig. 1) is accompanied by no increase whatever in toxicity to laboratory animals while the irritant properties of the successive compounds actually becomes diminished.

Hexylresorcinol, the most powerful member of this series according to the United States Hygienic Laboratory method of measuring germicidal values, is now known to possess a phenol coefficient of 72 (9). Its structural formula (5, 10, 11) is as follows:



When it is considered that this compound shows an increase in germicidal power over that of resorcinol, its mother substance, of over twenty thousand per cent (20,000 per cent) without any increase in toxicity or irritant properties, and that the intermediate members of the series show regular and proportionate development of these properties with each increase in the weight of the alkyl chain, it would appear that a fundamental relationship between chemical constitution and the particular properties to be desired in a germicide has been definitely established for this type of compound.

## HEXYLRESORCINOL

With reference to the properties of hexylresorcinol in relation to the six qualifications enumerated above as essential to an effective surface disinfectant, the first three may be dismissed very briefly.

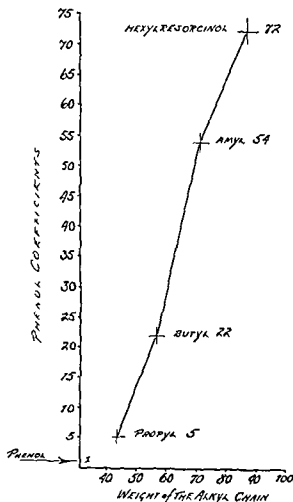


Fig. 1. The bactericidal power of the alkyl resorcinol increases in direct proportion to the sum of the atomic weights of the atoms in the alkyl chain. The phenol coefficient is shown opposite each compound. The level of the bactericidal power of phenol (unity) is shown in the lower left corner.

1. Hexyl resorcinol is a stable chemical compound. Aqueous solutions retain their bactericidal activity after months of standing at room temperature.

Hexyl resorcinol is non-toxic. It can be administered to man in large doses (0.6 gram three or four times daily) for a year or more without any untoward effect (4). It is by far the most powerful germicide ever described and is a non-toxic substance.

3. Highly bactericidal dilutions of hexyl resorcinol are absolutely devoid of irritant properties.

A study of the possibilities of the alkyl resorcinol as tissue surface disinfectants originated in the observation that aqueous solutions of hexyl resorcinol which would destroy all the common pathogens so quickly (less than 15 seconds) that the time could not be accurately determined appeared to be entirely devoid of irritant properties. Examination of all of the commonly used antiseptics and germicides indicated that their relative inefficiency in tissue surface disinfection was due chiefly to the fact that highly active dilutions were almost invariably found to be highly irritating, as well.

A detailed investigation of the unique properties of hexyl resorcinol has now furnished a satisfactory explanation of the astonishing speed and power of its bactericidal action. A summary of this work necessarily involves a brief discussion of the mechanism of disinfection by chemical means in association with the physical factor known as surface tension.

#### THE ROLE OF SURFACE TENSION IN DISINFECTION BY CHEMICAL MEANS

Respiration, nutrition, and the excretion of waste products by all vegetative cell bacteria included is carried on exclusively by diffusion of the various substances concerned in their metabolism through the limiting cell membrane. Only in this manner may the living protoplasm contained within this membrane continue its existence (Fig. 2A).

The poisoning of a bacterial cell by a germicide in solution is dependent upon the diffusion of the disinfecting substance through the cell wall which may or may not be destroyed in the process. The destruction of the protoplasm is now generally regarded as the result of a chemical reaction between it and the germicidal substance (Fig. 2B and C). This view is based upon experimental evidence by a number of investigators, notably Chalk (5) who has shown that disinfection by chemical means is an orderly three process exhibiting all of the mathematical characteristics of a unimolecular reaction such as the hydrolysis of proteid or emulsin.

Were we dealing with naked protoplasm disinfection by chemical means would probably

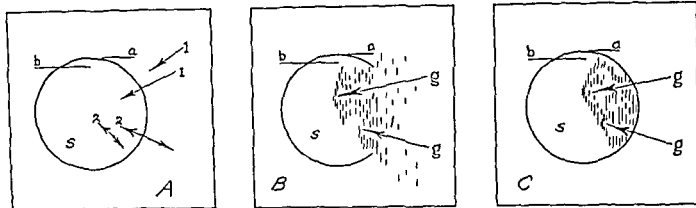


Fig. 2 Diffusion in vital processes and in chemical disinfection. S a spherical organism, a the cell wall, b the protoplasm. In A 1 represents the diffusion of nutritive material through the cell wall, 2 represents the respiratory exchange and excretion of waste products by diffusion through the cell wall. In B is shown the diffusion of germicide (g) into the bacterial cell with destruction of the cell membrane and escape of protoplasm. In C is shown the diffusion of germicide (g) into the cell without destruction of its limiting membrane, the death of the organism (S) resulting from a chemical reaction between the protoplasm and germicide represented by the shaded area.

follow the laws governing all chemical reactions between reactive substances in solution. The situation is complicated by the fact that one reagent (the protoplasm) is separated from the other (the germicide) by a semi-permeable membrane (the cell wall) through which the latter must diffuse before the reaction (disinfection) can occur. It is evident therefore that the germicide to be reactive, must exist in solution and that any factor which would tend to increase the rate of its diffusion through the cell wall would increase its bactericidal efficiency.

Now it has been observed (8) that if a surface tension reductant is added to a germicidal

solution both the velocity of disinfection and actual bactericidal power of that particular dilution of the germicide may be markedly increased in spite of the fact that the substance added has no toxic action whatever on the test organism. This phenomenon is due to an increase in the rate of diffusion of the germicide into the bacterial cell (1).

As illustrated diagrammatically in Figure 3 a certain number of molecules of a germicide in solution will diffuse through the cell wall of the organism within a given time (Fig. 3 A). On the addition of a surface tension reductant which has no antiseptic action whatever, the rate of this diffusion is increased

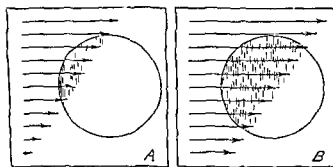


Fig. 3 The influence of surface tension on the rate of diffusion. The circles represent spherical organisms, the arrows represent molecules of germicide. The rate of diffusion is indicated by the progress of the arrows from left to right within a given time. A shows diffusion of the germicide through the cell membrane in a given time. B on lowering the surface tension of the solution diffusion is accelerated and the organism receives a larger amount of germicide within the same time interval. Consequently higher germicidal values are obtained for the same concentration of germicide.

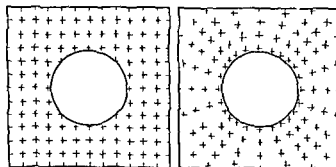


Fig. 4 The adsorption by bacteria of germicides which reduce surface tension. The circle represents a spherical organism in suspension in a germicidal fluid. Left figure shows dispersion of molecules in solution of a germicide which does not reduce surface tension showing equal distribution of the germicide throughout the solution. Right figure shows concentration of molecules of a germicide which itself reduces surface tension about the surface of the organism, by mechanical adsorption. The rate of diffusion of the germicide into the cell is also increased under these circumstances.

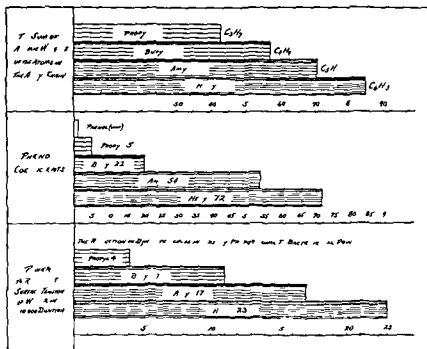


Fig. 5 The bactericidal power of the alkyl resorcinols increases in direct proportion to the weight of the alkyl chain and their power to reduce the surface tension of water

(Fig. 3 B) In an equal length of time the organism is penetrated by a larger amount of the germicide. This naturally increases the *velocity* of disinfection and therefore higher germicidal values are obtained with the same dilution of the germicide within the time limits of the experiment.

It is a well known fact that substances which reduce the surface tension of their solvents tend to collect about any surface or particle which may be in contact with the solution. This phenomenon is known as *mechanical adsorption* and the extent to which a surface tension reductant in solution will collect about particles in suspension is directly proportional to its surface tension reductant properties. Germicides which dissociate readily in solution such as hydrochloric acid may be electrically adsorbed by oppositely charged particles with little or no effect on the surface tension of the solution. If two surface tension reductants are present in the same solution the more powerful one will displace the weaker one from these surfaces.

Bearing these fundamental physical factors in mind it is evident that *if the germicide itself is a surface tension reductant* its molecules, which would be equally distributed throughout the solution in the absence of any solid particles in suspension in it, such as bacteria would be immediately adsorbed upon the surfaces of any bacteria (or other particulate matter) which might be added to the solution (Fig. 4).

Thus germicidal substances which reduce the surface tension of their solutions actually become concentrated at the most effective point i.e. on the surface of the organism. The concentration of such a germicide in the immediate vicinity of an organism suspended in a solution containing the germicide in a dilution for instance of 1:1000 will be actually greater than 1:1000. Add to this the fact that under these circumstances the rate of diffusion of the germicide into the bacterial cell is accelerated and it becomes plainly evident that other things being equal a germicide which reduces surface tension will be more efficient than one which does not (8).

Hexylresorcinol is an extremely powerful surface tension reducent. Its activity in this regard is practically equivalent to chemically pure sodium oleate (14, 15). The relation of surface tension reduction by closely allied compounds to their actual bactericidal power is beautifully illustrated by the alkyl resorcinols. With each increase in the weight of the alkyl chain in the successive compounds of this series up to the hexyl derivative the power to decrease the surface tension of water is sharply and regularly increased.

This increase is directly proportional to both the sum of the atomic weights of the atoms in the alkyl radical and to the increased germicidal power exhibited by each successive compound. This relationship is shown graphically in Figure 5. Hexylresorcinol occupies the peak in this series. Were it not for the fact that a sudden decrease in water solubility occurs in the higher derivatives (heptyl, octyl, nonyl, decyl, etc.), this process could be extended indefinitely with the development of germicidal compounds of enormous potentialities.

Figure 6 illustrates the surface tension apparatus devised by Count du Nouy (6) which was employed in making all of the surface tension measurements reported in this paper.

#### THE INFLUENCE OF SURFACE TENSION ON THE PERMEABILITY OF BACTERICIDAL SOLUTIONS

All tissue surfaces contain numerous microscopic crevices and interstices, the depths of

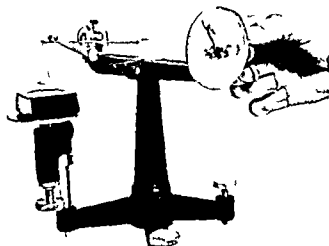


Fig. 6 The du Nouy surface tensiometer (6)

which may contain large numbers of organisms. The penetration of the disinfecting solution into the depths of these irregularities in surface is absolutely essential to complete disinfection. Here, again, the solution of low surface tension possesses great advantages, as illustrated by many familiar phenomena. For instance, oils will soak readily through thick wooden planks and alcohol or ether will be immediately absorbed by closely woven fabrics upon the surface of which water remains as discrete droplets. While, as Frobisher (8) has indicated, certain limitations due to viscosity and capillary rise must be considered in interpreting any generalization, it may be stated that under equivalent conditions *the strong retaining surface film of the fluid of high surface tension prevents its*

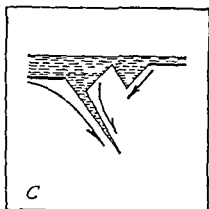
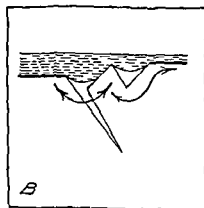
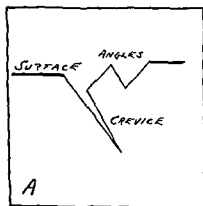


Fig. 7. Penetration by fluids of low surface tension. A Microscopic irregularities in surface. B The same surface covered by a fluid of high surface tension. The strong retaining surface film prevents its extension into the

depths of angles and crevices. C The same surface covered by a fluid of low surface tension. The readily extensible surface film allows a labile process to flow into each irregularity in surface.

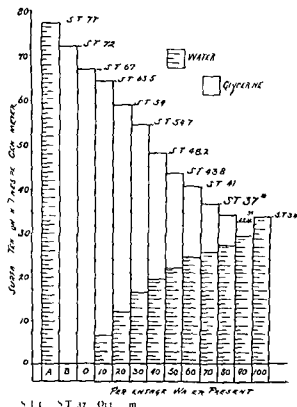


FIG. 8. ST 37 O.1 m

Fig. 8. Depression of the surface tension of solutions of hexylresorcinol (1:1000) in aqueous glycerine as the percentage of water is increased. A pure water B pure glycerine O pure glycerine with 1:1000 hexylresorcinol 100 pure water with 1:1000 hexylresorcinol 10 per cent of water in each solution. Height of column indicates surface tension.

extension into minute crevices and interstices the depths of which may be readily penetrated by the easily extensible surface film of the fluid of low surface tension (Fig. 7).

The power and velocity of bactericidal action shown by high dilutions of hexylresorcinol as well as the penetrability of these solutions are closely associated with its marked surface tension reducing properties. The fact that hexylresorcinol is a powerful surface tension reducer in addition to its inherent germicidal properties enables it to meet the fourth and fifth qualifications enumerated above.

#### FACTORS DETERMINING THE CHOICE OF A SOLVENT FOR HEXYLRESORCINOL

The problem of finding a suitable medium or vehicle by which hexylresorcinol could be

employed as a general antiseptic without loss of any of its advantages has been one of considerable difficulty owing to its sparing solubility in water. A large number of organic solvents have been investigated and discarded for one reason or another. Glycerine was finally selected as the solvent to which the fewest objections could be raised.

Surface tension measurements of glycerine solutions containing various concentrations of hexylresorcinol furnished very unexpected results. In spite of its power to reduce the surface tension of water hexylresorcinol was found to reduce the surface tension of glycerine only to a comparatively slight extent. This objection would have ruled out glycerine as a solvent had it not been found that the presence of water in these solutions released the surface tension depressant properties of the hexylresorcinol. Investigation of this seemingly anomalous situation in which the addition of pure water to a solution reduced its surface tension in direct proportion to the amount of water present has yielded experimental results which offer striking proof of the accuracy of Trobisher's deductions and the ideas expressed in this paper relative to the influence of surface forces in chemical disinfection. The details of these experiments are being published elsewhere (16).

In a study of solutions containing various proportions of hexylresorcinol, glycerine and water the following requirements were sought:

1. Sufficient hexylresorcinol present to insure very rapid disinfection (15 second) at body temperature not only in the original solution but in those dilutions which might result from its application to moist mucous membranes.

2. Sufficient glycerine present to ensure perfect solution of the hexylresorcinol under any conditions of dilution with water.

3. Sufficient water present in the glycerine to secure the lowest possible surface tension.

4. A minimum of irritant properties.

Without repeating the details of the experiments which led to its selection (16), the exact composition finally chosen is but meeting these four requirements was found to be a solution consisting of 30 per cent glycerine and 70 per cent water in which is dis-

solved one milligram of crystalline hexylresorcinol per cubic centimeter and which possesses a surface tension of 37 dynes per centimeter<sup>1</sup>

As a matter of convenience this particular composition has been designated as "solution S T 37" and will be referred to as such in the remainder of this paper

Figure 8 illustrates the striking effect of increasing percentages of water on the surface tension of solutions of aqueous glycerine each containing 1 milligram of crystalline hexylresorcinol per cubic centimeter

In the preparations containing 80 per cent and 90 per cent of water, there is insufficient glycerine present to hold the hexylresorcinol in solution

#### THE PROPERTIES OF SOLUTION S T 37

Bactericidal properties are ordinarily determined by the employment of time intervals in test tube experiments ranging from 2½ to 15 minutes or longer. The astonishing rapidity with which all of the commoner pathogenic test organisms were destroyed necessitated a reduction of these time intervals to a matter of seconds. Even under these circumstances the shortest time which could be employed with accuracy (15 seconds) was found to be too long, in that every type of test organism exposed to solution S T 37 for this period was invariably destroyed (see Table I)

Such organisms as *endamoeba coli*, *iodamoeba williamsi*, *spirochaetae*, such as *leptospira icterohaemorrhagiae* and various flagellates such as *trypanosoma lewisi* and *trichomonas hominis*<sup>2</sup> are instantly destroyed and disappear completely on contact with solution S T 37 in less than 5 seconds

Since any germicidal solution must suffer at least some dilution when applied to a moist surface such as a mucous membrane, the bactericidal activity of various dilutions of solution S T 37 was determined, employing *staphylococcus aureus* and *bacillus typhosus* as test organisms. The results are shown in Table II. The details of the technique are being published elsewhere and will not be repeated (16)

Even in a dilution of 1 to 10, solution S T 37 retains sufficient bactericidal power to destroy *bacillus typhosus* in less than 15 seconds and *staphylococcus aureus* in less than 1 minute

This observation is of importance in clinical application in that the solution may be diluted to considerable bulk, for such purposes as irrigation, without destroying its rapid bactericidal properties. It should be noted, however, that the surface tension rises with each dilution as shown in Table II. This undoubtedly reduces the permeability of the solution to some extent but since the highest surface tension recorded (53 dynes per centimeter for the 1 to 10 dilution) is still very low, being 24 dynes per centimeter less than that of water, this increase in surface tension should not interfere very materially with the efficiency of the solution

The stability of solution S T 37 in the presence of organic matter in the form of a standard mixture containing 2 per cent of peptone and one per cent of gelatine, together with the bactericidal activity of various dilutions tested under these circumstances is shown in Table III. Dilutions higher than that obtained on the addition of three parts of water were not investigated since this dilution is absolutely devoid of irritant properties even when applied to the most sensitive mucous membranes. Its bactericidal activity is fully retained nevertheless (15 second standard) under conditions (Table III) which largely or completely destroy the microbicidal power of most germicides

The optimum dilutions of solution S T 37 for use in the disinfection of various tissue surfaces appears to be, within certain limits, a matter to be determined by the individual case. The solution may be used full strength on the skin, in fresh cuts and abrasions, on granulating surfaces, and in abscess cavities and sinuses. It may also be employed full strength in topical applications in the ear, nose and throat, mouth, etc.

Instillations of solution S T 37 diluted with either one or two parts of water depending on the case, may be employed in the urethra and bladder and for renal pelvic lavage

<sup>1</sup> One dyne is equivalent to a lifting force of 21, gm.

<sup>2</sup> We are indebted to Dr. L. B. Lange and to Mr. Conrad Bauer of the Department of Medical Zoology for this material



TABLE I—THE VELOCITY OF BACTERICIDAL ACTION OF SOLUTION ST 37 + MEANS GROWTH o STERILE

Test o g n sm	Control	15 sec	3 sec	60 sec	Cultu e med
<i>Bacillus coli</i>	+	o	o	o	Witte peptone broth
<i>Bacillus typhosus</i>	+	o	o	o	Witte peptone broth *
<i>Bacillus pyocyaneus</i>	+	o	o	o	Witte peptone broth *
<i>Bacillus proteus</i>	+	o	o	o	Witte peptone broth *
<i>Staphylococcus albus</i>	+	o	o	o	Witte peptone broth *
<i>Staphylococcus aureus</i>	+	o	o	o	Witte peptone broth
<i>Bacillus diphtheriae</i>	+	o	o	o	Beef infusion broth
<i>Bacillus holmanni</i>	+	o	o	o	Beef infusion broth
<i>Streptococcus haemolyticus</i>	+	o	o	o	Beef infusion broth
<i>Streptococcus viridans</i>	+	o	o	o	Beef infusion broth
<i>Pneumococcus Type I</i>	+	o	o	o	Beef infusion broth
<i>Pneumococcus Type IV</i>	+	o	o	o	Beef infusion broth.
<i>Micrococcus catarrhalis</i>	+	o	o	o	Beef infusion broth
<i>Micrococcus meningitis</i>	+	o	o	o	Beef infusion broth
<i>Micrococcus gonorrhoea</i>	+	o	o	o	Brain infusion broth.
<i>Spirillum metchnikovi</i>	+	o	o	o	Witte peptone broth

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TABLE II—THE VELOCITY OF BACTERICIDAL ACTION OF VARIOUS DILUTIONS OF SOLUTION ST 37 + MEANS GROWTH o STERILE

Dilut o s l u t n S T 37 with d s t i l e d w t	S T	Bac il l s typh s t				St phylococ us a re s			
		Co t ol	15 sec	3 sec	6 sec	Co t ol	15 sec	3 sec	6 sec
With one part water	39 6	+	o	o	o	+	o	o	o
With two parts water	43	+	o	o	o	+	o	o	o
With three parts water	45 7	+	o	o	o	+	o	o	o
With four parts water	47	+	o	o	o	+	o	o	o
With five parts water	49	+	o	o	o	+	o	o	o
With six parts water	50 4	+	o	o	o	+	o	o	o
With seven parts water	51 1	+	o	o	o	+	o	o	o
With eight parts water	51 8	+	o	o	o	+	+	o	o
With nine parts water	53 8	+	o	o	o	+	+	+	o

Surf ete s n dyes p r c ntimate f flopp n str Phenol coefficient st d rd f T st previ u ly described (7)

TABLE III—THE STABILITY OF SOLUTION ST 37 IN THE PRESENCE OF ORGANIC MATTER

Dilut o s l u t n ach co t in g s per ce t f p tone ad s per cent g latine	Bacillus typhosus				Staphylococcus aureus			
	Cont ol	15 sec	30 sec	60 sec	Control	15 sec	30 sec	6 sec
Undiluted	+	o	o	o	+	o	o	o
Diluted with one part water	+	o	o	o	+	o	o	o
Diluted with two parts water	+	o	o	o	+	o	o	o
Diluted with three parts water	+	o	o	o	+	o	o	o

See foot te i bl II

Diluted with two volumes of water solution S T 37 may be instilled in the normal conjunctival sac.

For irrigations of any tissue surface in which a considerable bulk of fluid is essential and also as wet dressings on infected wounds and denuded surfaces, dilutions up to 1:5 may be employed (see Table II).

Clinical results with solution S T 37 in tissue surface disinfection will be reported in subsequent communications.

### CONCLUSIONS

A solution containing 30 per cent of glycine and 70 per cent of water in which is dissolved 1 milligram of crystalline hexylresorcinol per cubic centimeter, possesses a surface tension of 37 dynes per centimeter (solution S T 37) and represents the optimum composition of the solutions investigated for the following reasons:

- 1 It is stable and non toxic
- 2 All the major types of pathogenic microorganisms are destroyed in less than 15 seconds on contact with this solution
- 3 Its bactericidal power is fully retained (15 second standard) in dilutions which are absolutely devoid of irritant action on the most delicate tissue surfaces
- 4 Its bactericidal power is fully retained (15 second standard) in all dilutions likely

to be encountered in clinical application as well as those found in the presence of organic matter

5 The hexylresorcinol is held in perfect solution in all dilutions

6 The surface tension of the solution is very low

7 It is water clear and odorless

8 It does not attack any of the heavy metals

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OBSERVATIONS ON THE PREVENTION OF POSTOPERATIVE PERITONITIS AND ABDOMINAL ADHESIONS<sup>1</sup>

By HERBERT L. JOHNSON, M.D., BOSTON, MASSACHUSETTS

**I**N dealing with the subject of prevention of peritonitis and abdominal adhesions one must review the normal method of reaction to peritoneal inflammation.

Deaver (1) writing upon the subject of adhesions classified them into two main groups: congenital and acquired. With the congenital we are not concerned as their origin or function has not been proven. The acquired adhesions are subdivided into two natural divisions: inflammatory and operative. Inflammatory adhesions may be constructive as well as destructive. This latter sub-classification is entirely in keeping with my own observations: the constructive adhesions representing the deposit of fibrin in the primary reaction against peritoneal inflammation and the destructive corresponding to fibrin which has become firmly organized into dense unabsorbable adhesions.

Among the causes of abdominal adhesions mentioned by Deaver are collections of blood in the peritoneal cavity, sutures, ligatures, use of the cautery, exposure of the viscera, chemical irritation and infection. The prophylaxis offered by Deaver against this complication is a careful operative technique, strict asepsis, avoidance of trauma and visceral exposure. Nothing in my method lowers this standard of careful operative technique.

This same author in referring to the early reaction to an inflammatory process or a beginning peritonitis describes a serous effusion containing phagocytic cells. In addition to this serous effusion there is formed a fine layer of fibrin which covers the visceral layer of the peritoneum. The agglutination of the coils of bowel (constructive adhesions) is due to their being covered by this fine layer of fibrin. This latter serves to protect the endothelium from the action of toxins and enables the intestinal surfaces to adhere, thus mechanically limiting the spread of infection. It also provides fine strands or ladders along which the phagocytes may travel on their way

to the scene of action. This fibrinous exudate in the absence of a severe peritonitis or extensive trauma is usually absorbed before adhesions have had a chance to form. The method of this absorption is well brought out by McCallum (3).

"Many writers have recognized the power of certain tissues to digest themselves *in vitro* (autolysis) and have observed the neutrophile leucocytes produce a strong proteolytic ferment capable of digesting fibrin, gelatin, etc. Most of them, however, according to Wiener, have denied the production of a ferment of lymphoid cells. Opie has cleared the matter up very well by finding that the ferments of different cells required for their activity, different reactions. He states that the polymorphonuclear neutrophile leucocytes and their ancestral granulated cells produce a trypsin-like ferment which acts best in an alkaline or neutral medium to digest proteins. Its action is often combated by an anti-enzyme which is present in the plasma of the blood and other body fluids. It is resistant to heat up to 70 or 75 degrees centigrade and is therefore quite different from the complement of the serum which is destroyed at 55 degrees centigrade. When formed in great concentration in a focal area of inflammation the enzyme far outstrips the neutralizing anti-enzyme and brings about the liquefaction of dead tissue as in the case of an abscess. Large collections of fluid tend to retard its action."

This proteolytic ferment Opie calls leucoprotease. While these ferments are evidently used inside the cell in the case of the particles which have been ingested, it seems certain that in the formation of pus, as in the abscessed bodies, they are diffused from the bodies of the disintegrating leucocytes and in the free fluid effect the solution of the adjacent injured and dead tissue. This function of the wandering cells is of course of immediate importance in connection with their task of cleaning up the injured area to prepare it for re-

<sup>1</sup>Read before the combined staff of the Fifth Avenue Hospital, New York, March 2, 1917.

pair While the proteases thus produced are active in the solution of undesirable material their unbridled action might be detrimental As a matter of fact, it is shown by Jobling and Peterson that the antiferment known to be present in the serum and to restrict the action of the ferment is a recognizable chemical substance, usually a soap or other combination of an unsaturated fatty acid It is possible to remove or decompose this substance or to saturate the fatty acid with iodine and thus release the ferment to its full activity The presence of excess of such soaps in the tubercle bacilli seems to be the cause of the delay of liquefaction of tissue brought to necrosis by this bacilli It is seen from this that we are at the beginning of our knowledge of the activities of wandering cells Other ferments they produce have been as yet only imperfectly studied although we have evidence that others, such as oxydases are produced by some of them and there are surely more of them "

From the long list of previous attempts at prevention of abdominal adhesions by a foreign substance, we are justified in concluding that no one method has proven satisfactory It is apparent from the known chemical action of some of the substances used, such as boric acid, sodium citrate salt solution, gelatin, gum, and paraffin that many previous writers sought to prevent rather than stimulate the normal reaction against peritoneal trauma and infection

Prominent among those recently contributing to the work on this subject is a Japanese surgeon, Takashi Kubota (2) of the Surgical Department of the Imperial University, Fu Kuoka, Japan His method of experimentation was first to determine a reliable method of producing adhesions on the experimental animal This was accomplished by rubbing the bowel with dry gauze until ecchymosis appeared and then painting with tincture of iodine 2 per cent, Lugol's solution, or 5 per cent silver nitrate He then used any of the then known methods of preventing abdominal adhesions Behan recommended the use of 5 per cent boric acid solution Pope used 2 per cent sodium citrate with 3 per cent hypertonic salt solution Walker used 3 per cent sodium citrate with 1 per cent salt solution

The end result of experiments done by these methods was medium or strong adhesions Vogel prescribed the use of sodium citrate, sodium chloride, and gum arabic solution A combination of humanol and liquid fat of animals of the same species recommended by Loeffler Hoellaender, Edin, Lindig, and Lachenberg gave better results than the other methods but still showed some adhesions The gelatin acacia mixture prescribed by Williamson and Frank also gave medium adhesions

Having determined the unsatisfactory results of these previous methods, Kubota planned a series of experiments on rabbits, using papain as the prevention agent He used dilutions of this substance ranging from 1:1,000, to 1:1,000,000 Anything less than 1:1,000 produced a marked inflammatory reaction with resultant adhesions, and any dilution over 1:500,000 also resulted in adhesions The dilution which gave best results was 1:200,000 This substance was applied to the eroded peritoneal surface and the abdomen closed Inspections were made at frequent intervals, ranging from 2 days to 4 weeks Kubota has graphically charted (Tables I, II, and III) the results of these experiments as compared with the first series in which previously known agents were used

It may be of interest at this point to speak of the origin and chemical properties of papain, as taken from Thorpe's *Dictionary of Applied Chemistry* Papain is "a vegetable digestive ferment obtained from the unripe fruit of carica papaya, or the pawpaw tree, active in neutral and alkaline media The juice, when dry, forms a powder resembling gum arabic Papain is the alcoholic extract Its action depends on the fact that it digests not only muscle fibre but connective tissue It digests fibrin and albumin in neutral and slightly alkaline media When injected into the circulation in large doses it paralyzes the heart In small quantities, it appears to favor the multiplication of micrococci in the blood "

In January, 1925, Naumann (4), of Germany, published a paper on the biological prevention of abdominal adhesions Basing his conclusions on the fact that an

TABLE I

Rabbit	Cases of adhesions	No. of days until examination	Adhesions	Remarks
1	Rub and tincture of iodine	24 hours	+	Slight fibrous adhesions
2	Rub and tincture of iodine	3 days	+	Slight adhesions
3	Rub and tincture of iodine	1 week	+	A firm adhesion around the small and large intestine forming a large mass
4	Rub and tincture of iodine	weeks	+	
5	Rub and tincture of iodine	3 weeks	+	
6	Rub and tincture of iodine	6 weeks	+	Slight fibrous adhesions
7	Rub and Lugol's solution	4 hours	+	
8	Rub and Lugol's solution	3 days	+	Slight adhesions
9	Rub and Lugol's solution	1 week	+	A firm adhesion around the small and large intestine and greater mass
10	Rub and Lugol's solution	3 weeks	+	
11	Rub and 5% silver nitrate	4 hours	+	Slight fibrous adhesions
12	Rub and 5% silver nitrate	1 week	+	Firm adhesions
Dogs	Rub and 5% tincture of iodine	1 week	+	Firm adhesions
	Rub and Lugol's solution	weeks	+	

Notes: The solutions were applied to the parts at the apex of a descending colon extended for 5 centimeters. Iodine tincture was used.

TABLE II

Rabbit	Cases of adhesions	Preparation methods	Amount injected	No. of days till examination	Adhesions	Remarks
13	Rub and 5% tincture of iodine	5% boric acid	5 gm	4 days	+	Slight fibrous adhesions
14	Rub and Lugol's solution		5 gm	2 weeks	+	Firm adhesions
15	Rub and 5% tincture of iodine	5% Sodium metate	gm	4 weeks	+	
16	Rub and 5% tincture of iodine		10 cm	4 days	+	Slight fibrous adhesions
17	Rub and 5% tincture of iodine	5% Sodium chloride	100 cm	1 week	+	Medium adhesions
18	Rub and 5% tincture of iodine	5% Sodium metate	1 cm	3 weeks	+	
19	Rub and 5% tincture of iodine		0.05 cm	weeks	+	Medium adhesions
20	Rub and Lugol's solution	5% Sodium chloride	0.05 cm	3 weeks	+	
21	Rub and 5% tincture of iodine	Sodium citrate	5 cm	3 weeks	+	Slight adhesions
22	Rub and 5% tincture of iodine	Sodium chloride	3 cm	weeks	+	Medium adhesions
23	Rub and 5% tincture of iodine	Gum arabic	5 cm	3 weeks	+	
24	Rub and Lugol's solution	Humanol	0.05 cm	1 week	+	Slight adhesions
25	Rub and 5% tincture of iodine		cm	2 weeks	+	
26	Rub and Lugol's solution	Hiroli	0.05 cm	3 days	+	Slight adhesions
27	Rub and 5% tincture of iodine		0.05 cm	4 weeks	+	
28	Rub and 5% silver nitrate	Gum arabic dgl (25% ch) 5% solution	5 cm	3 days	+	Medium adhesions
29	Rub and 5% silver nitrate		5 cm	4 days	+	
30	Rub and Lugol's solution		1 cm	1 week	+	

exudate rich peritonitis often heals up without adhesions and that in this recovery the peritoneal tissues play the offensive role, he produced experimentally on the dog so called sterile abscesses by the injection of turpentine oil together with a great quantity of physio-

TABLE III

Rabbits	Causes of adhesion	Kakkol solution %	Doses	No. of days until ileum intubation	Adhesion	Remarks
31	Rub and 2% tincture iodine	0.0001	10 c cm	8 days	+	Slight fibrinous adhesions around caecum colon and appendix
32	Rub and 2% tincture iodine	0.0002	10 c cm	10 days	+	Weak adhesions in mesentery of ascending colon and appendix
33	Rub and Lugol solution	0.0004	10 c cm	1 week	-	Almost no adhesions of intestines
34	Rub and 2% tincture iodine	0.0004	10 c cm	4 weeks	-	No adhesions
35	Rub and Lugol solution		10 c cm	2 days	-	No adhesions
36	Rub and 2% tincture iodine		10 c cm	2 days	-	No adhesions of intestines slight adhesion of mesentery
37	Rub and 2% tincture iodine	0.0005	10 c cm	2 weeks	-	No adhesions
38	Rub and Lugol solution		10 c cm	4 weeks	-	No adhesions
39	Rub and 2% tincture iodine	0.0006	10 c cm	10 days	-	No adhesions
40	Rub and Lugol solution	0.0008	10 c cm	4 weeks	-	No adhesions
41	Rub and 2% tincture iodine	0.001	10 c cm	4 days	-	No adhesions
42	Rub and 2% tincture iodine	0.001	10 c cm	6 days	-	No adhesions
43	Rub and Lugol solution	0.001	10 c cm	11 days	-	No adhesions
44	Rub and Lugol solution	0.002	10 c cm	1 week	-	Almost no adhesions
45	Rub and 2% tincture iodine	0.01	10 c cm	3 days	+	Slight congestion and adhesion at the area of application
46	Rub and 2% tincture iodine	0.01	10 c cm	10 days	+	Slight congestion and adhesion at the area of application
47	Rub and 2% tincture iodine	0.1	10 c cm	5 days	+	Slight congestion and adhesion at the area of application
48	Rub and 2% tincture iodine		10 c cm	1 week	-	No adhesions
49	Rub and 2% tincture iodine	0.0005	10 c cm	3 weeks	-	Almost no adhesions
50	Rub and 2% tincture iodine	0.001	10 c cm	4 days	-	Almost no adhesions
51	Rub and 2% tincture iodine	No preventive method used	-	4 days	-	Firm adhesions
52	Rub and 2% tincture iodine	0.001	10 c cm		-	Firm adhesions at anastomosis no abnormal adhesion around
53	Rub and 2% tincture iodine	0.0005	10 c cm		-	Firm adhesions at anastomosis no abnormal adhesion around
Dogs 3	Rub and 2% tincture iodine	0.0005	10 c cm	2 weeks	-	No adhesions
4	Rub and Lugol solution	0.001	10 c cm	2 weeks	-	No adhesions

logical sodium chloride solution into the peritoneal connective tissue. By this method, he claims to have stimulated an excessive production of leucoprotease which, by its proteolytic effect, digested adhesions.

While this work may seem complicated and of uncertain value, it at least emphasizes the important effect of the digestive action of the proteolytic ferment protease.

In October, 1922, I was called to see Mrs. M. C., aged 33, 8 months pregnant with her first baby. She had full placenta previa with a history of profuse hemorrhage increasing in quantity for the last 3 weeks. An alarming secondary anemia had developed and because of the refusal of the patient to submit to blood

transfusion, a quick abdominal cesarean operation was determined upon. It occurred to me on opening the abdomen that it would be valuable to transfuse intra-abdominally with blood which flowed during the operation. This necessitated a change in the old technique. Instead of keeping the uterus tight against the wound margin to prevent the spilling of uterine contents into the abdominal cavity, an effort was made to leave the blood in the pelvis. Much amniotic fluid was unavoidably mixed with it. The immediate and remote postoperative results were extremely satisfactory.

Later, I tried this method in cases in which there seemed little likelihood of infection for

TABLE IV — ANALYSIS OF CAESAREAN SECTION SERIES OF 53 CASES ABDOMEN FILLED WITH AMNIOTIC FLUID AND BLOOD

	Primary indication for cesarean section	No. of operations	Adhesions seen at operation	Postoperative condition	Clinical peritonitis	Death
Primary laparotomy by writer	Contracted pelvis	21	None	Good	0	
	Nephritis toxemia	4	None	Good	0	0
	Presents extensive perineal pain	3	None	Good	0	
	Placenta previa severe hemorrhage	3	None	Satisfactory shock	0	0
	Pelvic carcinoma ectopic	2	Moderately extensive	Good	0	
	Dyspareunia	1	None	Good	0	
	Ruptured uterus		None	Fatal	0	0
	Total	35				
Re-operations	Contracted pelvis	16	Slight to none	Good		
	Nephritis toxemia	0	0		0	
	Presents extensive perineal pain	1	None	Good	0	
	Placenta previa severe hemorrhage	0	0	0	0	0
	Pelvic carcinoma ectopic	0	0	0	0	0
	Dyspareunia	0	0	0	0	0
	Ruptured uterus	1	None	Poor	0	0
	Total	8				

On case showed adhesions between parietal peritoneum and uterus. On case showed adhesions between parietal peritoneum and uterus. On case showed adhesions between parietal peritoneum and uterus.

the purpose of noting the postoperative effect. This was so uniformly and exceptionally good that I soon adopted the method as routine in all cases. I have collected a series of 53 abdominal cesarean sections done by this method and present them for your inspection in table form (Fig. 4). In 18 of these a second operation was performed which gave me a chance to inspect the remote results of this new technique. Two cases are especially worthy of note inasmuch as infection must have been present at the time of operation.

In one case the uterus had ruptured 24 hours before I was called to operate. In the other case one of disproportion, several attempts had been made to deliver with instruments over a period of 6 hours. In these cases this newly adopted technique was used and the abdomen closed around a small cigarette drain. In both the drain was removed at the end of 48 hours and no primary or secondary peritonitis developed.

As to the origin and function of amniotic fluid an extract from Williams (5) gives briefly the present attitude of authorities in this field of investigation.

"The biochemical investigations of Polano show that the amniotic fluid does not contain certain antibodies found in the maternal serum which should be present were the former mere transudate while the amniotic fluid and maternal serum lack a staphylolysin which is present in the fetal urine. Consequently he concluded since the amniotic fluid was derived neither from the maternal serum nor from the fetal urine that the only origin possible must be a direct secretory action on the part of the amniotic epithelium.

"It (the amniotic fluid) also subserves an important function by preventing the formation of adhesions between the fetus and the walls of the amniotic sac which when they occur often give rise to serious deformities. In order to gain further knowledge of the immediate action of amniotic fluid on the

TABLE V—EFFECT OF COW AMNIOTIC FLUID ON GUINEA PIGS, INTRAPERITONEAL INJECTIONS, FLUID STERILIZED BY BERKEFELD FILTRATION

No	Pig killed	Adhesions	Plastic exudate	No change
10	48 hrs	0	x	
11	8 days	0	0	x

TABLE VI—EFFECT OF BOILED AND UNBOILED HUMAN AMNIOTIC FLUID ON GUINEA PIGS, INTRAPERITONEAL INJECTIONS, PIGS KILLED AT 30 DAYS

No	Fluid used	Firm adhesions	Moderate adhesions	Slight adhesions	Elastic exudate	No change
1	Boiled	0	0	0	0	x
2	Boiled	0	0	0	0	x
3	Unboiled	0	0	0	0	x
4	Unboiled	0	0	0	0	x
5	Unboiled	0	0	0	0	x

TABLE VII—SERIES CONTROL ON STUDY OF FORMATION OF ADHESIONS IN GUINEA PIGS, PARIETAL PERITONEUM AND INTESTINAL LOOPS MARKEDLY EXCORIATED, NO AMNIOTIC FLUID USED

No	Pig killed	Adhesions between gut and parietal peritoneum	Adhesions between loops of gut	Plastic exudate	No change
16	6 days	Many	Many	0	
12					
13	12 days	Many dense fibrous	Dense fibrous also gut to omentum	0	
14	20 days	Numerous dense fibrous	Numerous dense	0	
15	20 days	Dense (3) Delicate (2)	Omentum to gut	0	

Killed by other pigs on tenth day and majority of viscera eaten (sharp kink of bowel leading to partial obstruction)

peritoneum, I resorted to a series of experiments on guinea pigs. The actual pathological work was carried out by Dr Shields Warren of the Department of Pathology, Harvard Medical School. Because of the difficulty of obtaining human amniotic fluid uncontaminated with blood, we resorted to the use of cow fluid. Its effect upon the pigs was similar to that of the human fluid. Before using it in

TABLE VIII—EFFECT OF AMNIOTIC FLUID ON FORMATION OF ADHESIONS IN GUINEA PIGS, PARIETAL PERITONEUM AND INTESTINAL LOOPS MARKEDLY EXCORIATED, FILTERED, STERILE BOVINE FLUID (BOILED)

No	Pig killed	Adhesions between gut and parietal peritoneum	Adhesions between loops of gut	Plastic exudate	No change
17	Died 6th day	Numerous fibrinous and delicate fibrous bands	None	+	
20	12 days	Moderate	Delicate (2)	0	
18	15 days	Moderate	Omentum to gut (1)	0	
19	15 days	Dense (1) Slight (2)	None	0	
21	15 days	Delicate (4)	Omentum to gut (1)	0	

TABLE IX—EFFECT OF AMNIOTIC FLUID ON FORMATION OF ADHESIONS IN GUINEA PIGS, PARIETAL PERITONEUM AND INTESTINAL LOOPS MARKEDLY EXCORIATED, FILTERED, STERILE BOVINE FLUID (UNBOILED)

No	Pig killed	Adhesions between gut and parietal peritoneum	Adhesions between loops of gut	Plastic exudate	No change
7	6 days	Moderate	None	0	
11	12 days	Moderate	None	0	
8	20 days	Very slight	None	0	
9	20 days	Moderate	Slight adhesion of omentum to gut	0	
10	20 days	Moderate	None	0	

any human abdomens, Dr Shields Warren, Dr Warren Johnson, and the writer submitted to intradermal inoculation to determine the foreign protein reaction. This was negligible. The use of small quantities (20 cubic centimeters) in the abdomen of a small number of patients postoperatively showed no local or general reaction.

The experiments on the guinea pigs were divided into three general groups: first, those in which boiled amniotic fluid was used; second, those in which filtered unboiled amniotic fluid was used; and third, the control group in which no amniotic fluid was used. In addition to these experiments, minor experiments were performed to demonstrate first, the presence or absence of complement, second



its value as a culture medium, third, its effect on human blood cells and fourth its injection intradermally to determine its foreign protein reaction. The results of the first three groups are best shown in table form (Tables V, VI, VII, VIII and IX).

The results in the others showed *first* amniotic fluid possesses a complement reaction equivalent to that of spinal fluid or  $\frac{1}{4}$  of that contained in normal pig serum. *second* amniotic fluid unmixed with other substances shows a moderate growth in response to inoculation with streptococcus and pneumococcus. *third* amniotic fluid mixed with equal quantities of human blood showed slight crenation of red blood cells after one hour and slight hemolysis at the end of 24 hours. *fourth* the fluid injected intradermally in three human subjects at the end of 24 hours showed a slight reaction and at the end of 48 hours had largely disappeared. At the end of 96 hours there was nothing visible.

In the experiments conducted to determine the action of amniotic fluid on the formation of adhesions. I feel that our zeal in securing firm adhesions led us to be excessive in our technique. The method used for the production of adhesions was as follows: the abdomen of the pig was shaved, the animal was anesthetized with ether and an incision made in the midline through the linea alba 2 centimeters in extent beginning at a point about 1 centimeter below the ensiform cartilage. A number of loops of bowel from 8 to 10 were exposed through the wound and rubbed briskly with sterile gauze until there was oozing of blood from their surfaces. These loops were left exposed for a period of about 5 minutes. During this time the abdominal wall was lifted up and the parietal peritoneum scraped thoroughly with a knife blade held at a right angle over an area centering at the incision about 4 centimeters in diameter. A considerable amount of red pulp on the knife bore evidence to the efficacy of this method in eroding the peritoneum. The abdomen was then sewed up with a continuous silk suture including muscle and peritoneum and with interrupted catgut sutures in the skin. The incision was then completely sealed over with collodion.

In the control pigs nothing further was done. In the first series of pigs 15 cubic centimeters of sterile Berkefeld filtered bovine amniotic fluid was injected into the peritoneal cavity at a point in the flank about  $2\frac{1}{2}$  centimeters from the line of incision. In the other series the same procedure was followed substituting boiled amniotic fluid for the filtered sterile fluid.

When one considers the extreme erosion of the parietal peritoneum about the wound and the fact that the guinea pigs normal position following operation would bring the eroded gut in firm and constant contact with this surface it is not to be wondered at that a certain number of adhesions were noted in every case at this point. It may also be noted that these adhesions occurred in the most dependent portion of the abdominal cavity. This would tend to rule out somewhat the theory that this fluid is effective by its mechanical presence. Fair conclusions in this series of experiments can be drawn only from the number and extent of the adhesions present between the loops of gut and the omentum as indicated in the table.

In considering the method of action of this fluid in preventing postoperative peritonitis and abdominal adhesions it is apparent from the pig experiments that its presence within the peritoneal cavity has the effect of immediately stimulating the laying down of a thin layer of fibrin on the peritoneal surface and the production of a moderate leucocytosis. The fibrin serves as a protection against the absorption of toxins and the spread of infection. The action of the leucocytes is to attack infection and produce the proteolytic ferment protease which results in the resolution of the protective layer of fibrin after need for its existence has passed and before it has become organized into firm connective tissue.

The action of the fluid is an exact imitation of the primary reaction of nature to peritoneal inflammation in the case of infection or trauma. The advantage is that this reaction is produced immediately before any possible infective agent has had a chance to pass the stage of incubation and attack the peritoneum in force. Whether the action of

this foreign substance is due to its chemical constituents or the presence of an enzyme or a combination of both is yet to be determined

In favor of the chemical action is the following paragraph taken from McCallum (3) "Many ideas have been expressed as to the reason for the passage of the leucocytes through the wall, but it seems that the weight of evidence is in favor of their active penetration through the cells in response to the attraction of some diffusible soluble substance which is either the injurious agent itself or produced by its destructive action on the cells of the tissue. It is so evident that dead tissue killed by any mechanical means or by being deprived of its blood supply, as in the case of an infarction, can act in this way to attract the leucocytes, that in every case it must play a part. Experimentally it has been shown that extracts of dead cells are positively chemiotactic. Nevertheless, the leucocytes appear in so much greater number when bacteria or some chemical irritant causes the inflammation that unquestionably these poisonous substances themselves have a powerful influence."

Supporting the enzyme theory, we have the fact that one of the chief functions of amniotic fluid is the prevention of adhesions between the amniotic membrane and the fetus, also the fact that in the experiments on laboratory animals, the boiled fluid did not produce as good results as the unboiled fluid sterilized by passing through the Berkefeld filter.

In using this fluid in the human abdomen the same method of sterilization is used as in the laboratory. Whether subsequent experiments in which concentrated, desiccated, or chemically altered amniotic fluid is used will prove this altered fluid of greater benefit in the prevention of postoperative peritonitis and abdominal adhesions will be determined by further experimentation and reported upon in a supplementary paper.

#### SUMMARY

1 Amniotic fluid is a logical substance to employ for the prevention of adhesions since one of its chief functions in its natural location is the prevention of adhesions between the amniotic sac and the fetus.

2 This fluid sterilized by the Berkefeld filter method is safe to use postoperatively in the abdominal cavity.

3 Its action in the peritoneal cavity is the immediate production of a protective layer of fibrin on the peritoneal surfaces and a moderate local leucocytosis followed later by complete resolution of the fibrinous deposit leaving no permanent injury to the serous surface.

4 Its method of preventing peritonitis is its quick effect in setting up a fibrinous wall of defense together with the stimulation of a moderate local leucocytosis. Its apparent method of preventing adhesions is by stimulating rapid resolution of the plastic exudate through the action of proteolytic ferments which in turn are due to the local leucocytosis.

5 Laboratory and clinical observations have proven beyond any reasonable doubt that the presence of this fluid postoperatively in the abdominal cavity exercises a distinct beneficial effect against the development of peritonitis and the formation of adhesions without deleterious effect.

6 The subject matter of this paper covers clinical and laboratory observations far too small in scope to act as a basis for final conclusion but large enough to justify a preliminary report on the work in hand. To this extent only is this paper offered as a scientific contribution.

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## ACUTE APPENDICITIS COMPLICATING PREGNANCY, LABOR, AND THE PUERPERIUM

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THE writer will first report ten cases of pregnancy complicated by appendicitis treated in the obstetrical and surgical services of the Methodist Episcopal Hospital since 1915. Following this the frequency, etiology, symptomatology, diagnosis and prognosis will be taken up in order and the paper concluded by a detailed survey of the question of treatment.

Very few cases of acute appendicitis occurring in the last trimester of pregnancy have been reported. DeLee has reported four, Wallace one and Grattan one. To these I add my case (Case 10).

Case 1. M. S., age 22, white, 11 para, was admitted to the Methodist Episcopal Hospital November 18, 1922 (Service of Dr. T. B. Spence). At the time of admittance this patient was 7 months pregnant. Her history showed that for several years she had suffered from intermittent attacks of lower abdominal pain, digestive disturbances and vomiting. Her entry in the hospital was occasioned by a sudden attack of pain in the lower abdomen, nausea, repeated vomiting and a slight chill. Abdominal palpation revealed typical signs of acute appendicitis. The leucocyte count was slightly increased and the urine negative. A prompt operation within 12 hours of the onset of pain was performed. The appendix was found acutely inflamed but not ruptured. After appendectomy with inversion of the stump the abdomen was closed without drainage. Convalescence was untroubled and although uterine contractions occurred they were easily controlled by morphine and the gestation progressed to term.

Case 2. E. D., age 34, white, 11 para, entered the Methodist Episcopal Hospital December 21, 1922 (Service of Dr. R. A. Wilson). This patient's history showed that an acute attack of appendicitis had occurred 4 years before admission to the hospital and had spontaneously subsided. There had been no trouble in the interval. When 2 months pregnant, severe abdominal pain with nausea and repeated vomiting occurred. The diagnosis was not difficult, typical signs of appendicitis being present. The leucocyte count was 20,000 with a polymorphonuclear ratio of 80 per cent. The urine findings were negative. In less than 8 hours from the commencement of the attack the abdomen was opened by means of a right rectus incision. Appendectomy

and inversion of the stump were performed for an acute suppurative condition without rupture and the wound closed without drainage. An uneventful recovery followed and the pregnancy went to term.

Case 3. M. W., age 20, white, 1 para, entered the Methodist Episcopal Hospital June 8, 1924 (Service of Dr. G. H. Davis). In this case there was a history of severe digestive disturbances for many years but no pain. When 6½ months pregnant, an attack of abdominal cramp like pain developed suddenly accompanied by nausea and repeated vomiting. She was treated at home for 3 days by the family physician who believed the trouble to be salpingitis but as she became progressively worse and vomited incessantly she was then sent to the hospital. The blood count at this time showed 24,000 leucocytes with 90 per cent polymorphonuclears. A diagnosis of appendicitis was made and immediate operation advised. A right rectus incision was used and a gangrenous and perforated appendix removed. A widespread peritonitis existed. A rubber tube to the pelvis and a cigarette drain to the abscess site were used for drainage. The patient's condition became progressively worse and she died 5 days later, despite every effort to save her life. Uterine contractions did not occur at any time.

Case 4. S. D., age 22, white, 11 para, entered the Methodist Episcopal Hospital October 11, 1924 (Service of Dr. Russell S. Fowler). Her history disclosed that she had suffered from a great deal of 'stomach trouble' for many years with occasional attacks of abdominal pain, the latter having been diagnosed upon two occasions as appendicitis. When 4 months pregnant another attack occurred much more severe than any previously experienced and well localized in the right lower quadrant. The blood count remained normal but because of the physical signs immediate operation was performed about 12 hours from the commencement of the attack. A McBurney incision was used and an acutely inflamed appendix found but rupture had not yet taken place. The organ was removed and the stump inverted. An uneventful recovery followed the pregnancy remaining undisturbed.

Case 5. D. G., age 29, white, 1 para, entered the Methodist Episcopal Hospital September 6, 1925 (Service of Dr. G. H. Davis). In this instance the history was entirely negative and the attack apparently a primary one. When 3 months pregnant severe sudden abdominal pain occurred rapidly localizing in the right lower quadrant. She vomited several times. The blood count was normal. The physical signs were typical and operation was per-

formed at once, although about 30 hours had elapsed since the commencement of the attack. The incision was made through the right rectus muscle and a localized peritonitis indicated that perforation was present. After the removal of a ruptured appendix, drainage was secured by the use of a split rubber tube to the infected site. Despite the use of large doses of morphine, the patient miscarried 5 days later. Following this her convalescence was uneventful and she made a perfect recovery.

CASE 6 J P, age 21, white, 11 para, entered the Methodist Episcopal Hospital April 11, 1924 (Service of Dr R M Beach). Her history disclosed considerable gastric distress for years, with occasional vague right sided pain. A sudden attack of lower abdominal cramps with two spells of vomiting caused her to enter the hospital. After a careful examination, a tentative diagnosis of right ectopic gestation was made because of the pelvic findings and a suggestive history. The possibility of appendicitis was also borne in mind. However, Leucocytes were 11,000, polymorphonuclears 78 per cent, and the red count normal. Operation by means of a mid line incision within 20 hours of the onset of the pain, revealed a gangrenous perforated appendix with considerable peritonitis. In the uterus was a pregnancy of about 6 weeks' duration. Appendectomy was performed and drainage instituted by means of a rubber tube to the pelvis and a cigarette drain to the infected area. An excellent recovery ensued with no disturbance of the pregnancy.

CASE 7 F H, age 28, white, 1 para, entered the Methodist Episcopal Hospital December 16, 1924 (Service of Dr O P Humpstone). At the time of entry she was three and a half months pregnant with a history of many attacks of abdominal pain, nausea and vomiting, for the last 2 years repeated, diagnosed as appendicitis. From the beginning of this pregnancy, these had become more frequent and severe. The appendix was removed through a right rectus incision and found to be kinked, thickened, and injected. No disturbance of the ovum followed, her symptoms were immediately relieved and they have not since returned.

CASE 8 E H, age 32, white, 11 para, entered the Methodist Episcopal Hospital March 27, 1925 (Service of Dr T B Spence). This patient had a definite history of chronic appendicitis for the last 4 years, with constant pain and frequent nausea and vomiting. The symptoms had become much worse during the pregnancy which was of 3 months' duration. The removal of a diseased appendix was followed by an uneventful convalescence and complete relief of symptoms.

CASE 9 V S, age 23, white, 11 para, entered the Methodist Episcopal Hospital December 12, 1926 (Service of Dr R A Wilson). For the last year frequent attacks of low grade appendicitis had occurred at irregular intervals, becoming more frequent and severe during her pregnancy which

was near the end of the fifth month. The appendix was removed by means of a right rectus incision and found to be retrocaecal, kinked and clubbed. An excellent recovery followed with a total absence of uterine contractions.

An analysis of the nine cases just reported reveals certain points of interest, namely:

1 In the six acute cases only one of the attacks was primary. In all the others a history of a pathological appendix was obtainable.

2 Pregnancy had an injurious effect in the 8 cases in which a diseased appendix existed. Marked exacerbation of symptoms occurred.

3 In the presence of a pregnancy, perforation and peritonitis appeared rapidly. Prompt diagnosis and operation gave the best results.

4 Of the three perforated cases, one died. If operated upon before perforation, however, recovery was rapid and without complication.

5 Only 1 case miscarried despite the fact that 3 of them required drainage.

6 The last 3 cases show operation performed largely as a prophylactic measure with excellent results and no disturbance of the fetus.

Case 10 is reported in detail because of its rarity, the difficult diagnostic problem it presented and the method of treatment which was followed.

CASE 10 N L, age 26, white, 1 para, consulted the writer March 15, 1925 when 3 months pregnant. Her history was negative with one important exception. In 1923, she had had a sudden attack of right sided pain and severe nausea, which had been diagnosed by her family physician and a surgical consultant as pyelitis. In view of later events, however, this diagnosis might well be doubted and careful questioning made it appear most probable that the attack was appendicitis. She had made a good recovery, however, without further symptoms. When first seen in the office the patient was in excellent health, her physical examination being entirely negative, the uterus in good position and about the size of a 3 months' pregnancy, blood pressure 110-65, urine negative. She was also examined on several occasions afterward and no pathological condition found.

On August 24, 1925, her pregnancy being then of about 8½ months duration, an urgent call was received to see her at home. She was found in bed evidently in great pain and having hard, regular contractions of the uterus. As labor appeared to be

in progress  $\frac{1}{4}$  grain of morphine was administered and immediate removal to the hospital advised. She was admitted to the Methodist Episcopal Hospital August 24 1925 at 500 p. m. and until operation was finally performed presented a problem of great interest.

Examination upon admittance showed her to be having painful uterine contractions every 2 minutes. There was some tenderness over the entire abdomen most marked in the right lower quadrant. No fetal heart could be heard. Vaginal examination disclosed a softened and somewhat thinned out cervix but no dilatation. A blood count at this time showed 20 000 leucocytes with 87 per cent polymorpho-nuclears. In view of the previous history a diagnosis of pyleitis with premature labor was made and suitable treatment instituted. A catheterized urine examination made a few hours later proved to be entirely negative and the diagnosis became questionable.

The next morning her general condition was worse the pain more severe but uterine contractions had stopped. The uterus was now definitely tense and quite tender. A surgical consultant after a careful survey stated that he could not make a definite diagnosis but in view of the blood count and the negative urine findings considered appendicitis a strong probability.

An obstetrical consultant about the same time however made a probable diagnosis of accidental hemorrhage of the concealed variety basing this diagnosis on the generalized tenderness of the uterus its increased tension and the absence of a fetal heart.

The patient was now very pale with a red cell count of 3 000 000 hemoglobin 65 per cent. The surgical consultant again examined the case and stated that in view of the marked uterine tension tenderness and apparent fetal death with a definite anemia intra uterine difficulty was the most probable diagnosis.

In the next few hours additional laboratory work was done which resulted in the definite ruling out of pyleitis and made the diagnosis rest between accidental hemorrhage and acute appendicitis.

A third consultant was now called in. After a most careful examination and consideration of all the facts he expressed the following opinion. While many of the signs are not clear I consider this a case of accidental hemorrhage. Appendicitis cannot however be ruled out definitely until the abdomen is opened. I advise immediate exploration.

As the patient's condition was growing worse she was prepared for operation which was performed during the evening of her second day in the hospital. During this time no nausea or vomiting had been present.

**Operation.** An ample right rectus incision was used. The uterus was a little mottled in appearance but clearly did not contain much if any free blood. It was protected with lap sponges and the region of the appendix carefully approached. Some flakes

of fibrin and marked congestion and edema were noticed. Exploration went no further for the time being. The uterus was quickly emptied through the classical incision and a living baby extracted which appeared toxic however was difficult to resuscitate and died a few hours later. The incision was closed in three layers by continuous sutures. With the uterine wound well protected the appendicular region was again approached and a pool of foul yellow pus welled forth. A long thick gangrenous appendix with a large perforation at its base was next brought into view. It was removed and the stump purse stringed with some difficulty because of the extensive edema of the cecum. A split rubber tube to the pelvis and a cigarette drain to the abscess site were used for drainage and the abdomen closed.

A severe lower abdominal peritonitis developed and for the next 4 days her condition was serious but on the fifth day a decided improvement took place. After this her convalescence was satisfactory the cigarette drain being removed on the tenth day and the tube progressively shortened and finally removed on the twenty second day. Thirty five days following operation she left the hospital with the wound completely healed. The lochia was at all times normal in quantity and character and apparently no infection of the uterine wound occurred. Since operation she has enjoyed excellent health and at this date (January 1 1927) is pregnant again being now in her sixth month.

In considering the appendix in women we would do well to remember that in many patients it is a pelvic organ, often in close proximity to the right adnexa and therefore easily involved if pelvic pathology exists. The appendiculo ovarian ligament contains lymphatics draining from the right adnexa and also in many cases a small branch of the ovarian artery (appendiculo ovarian). A decided reaction in the appendix has been observed, and recently certain writers have reported the presence of endometrial implants. We can thus readily see that it can be damaged by pelvic pathology, or it itself involve the pelvic organs.

Let us attempt to visualize what is occurring in the abdomen during pregnancy. As the uterus progressively enlarges, it presses upon the cecum and along with the appendix it is pushed upward and to the right. The omentum is also carried into the upper abdomen and cannot easily return. Sudden inflammation occurring during this time does not have the aid of the omentum or intestines to help in the localization of the process and the

uterus frequently becomes one of the limiting organs, but at the risk of being itself intimately involved. It is only by a realization of these factors and of the pathological changes next to be discussed that the rationale for the treatment of acute attacks of appendicitis occurring in the last trimester of pregnancy can be understood and defended if necessary.

As the pregnancy progresses, the cecum and appendix are subject to increasing pressure, if free and marked traction if adhesions are present, so that existing kinks are made worse and bands further tightened. It is thus easy to see how intestinal emptying is interfered with and old lesions irritated and activated.

If an attack should occur particularly in the late months, it is likely to be rapid and virulent in its course. The congestion and numerous large vessels present probably largely explain this so that only a comparatively short time elapses before perforation occurs in the great majority of cases. Localization of the process is poor or does not take place at all. There is no omentum and little if any small intestine to wall off the inflammation and the lateral uterine wall is directly involved. A marked reaction occurs resulting in an injected and sometimes edematous metritis. Contractions of the uterus follow in nearly all cases and markedly aggravate the inflammation and aid the spreading of pus, which easily finds its way to the upper abdomen.

When an abscess is present, the uterus is often part of its limiting wall and a sudden emptying of the uterine contents is likely to tear open the abscess and allow the pus to flow freely where it will. A few cases have been reported in which an appendicular abscess has burrowed and ruptured into the uterus, vagina, bladder, or rectum. In most cases, however, the tendency to spread is in the direction of the upper abdomen.

So that it can be stated that the problem is more difficult and complex than that encountered in the non pregnant woman.

#### FREQUENCY

Primary acute appendicitis does not occur more frequently in the pregnant than in the non pregnant woman and the cases reported

of this type are few. Case 5 does fall in this classification. There is no doubt, however, that pregnancy reacts unfavorably if the appendix has been the seat of previous trouble and aggravates the condition to a marked extent. Women in the early months of pregnancy often complain of such a number and variety of troubles that there is a general tendency to gloss over and ignore many of them. It is now becoming realized that many of the digestive symptoms and much of the abdominal pain and discomfort are undoubtedly due to the appendix.

Findley, in 1912 reported 15 cases of appendicitis complicating pregnancy in which 14 had suffered from previous attacks. He further stated that at least 70 per cent of those women who have had appendicitis prior to gestation will suffer more or less from this cause during a subsequent pregnancy. Fekner some time ago made a report concerning observations on 3,800 cases of pregnancy. He stated that a return of appendicitis was observed to take place in all the cases in which it was previously known to have existed, with but one exception. It can be safely stated that pregnancy and a previously diseased appendix are not compatible.

This complication occurs most frequently between the third and sixth months less frequently in the first three and only rarely in the last trimester. Donahue definitely states that 80 per cent of all cases occur in the first 6 months.

In considering the puerperium, we find that no figures are available. It is easy to understand however, how often this condition might be present and yet be overlooked. It would be well to bear in mind that not all temperature, pain, tenderness, and rigidity at this time are due to puerperal infection. The appendix should be investigated as well as our attention directed to the possibility of other disease, such as degenerating fibroids, a twisted ovarian cyst, etc.

It occurs with equal frequency at all ages during the childbearing period. It is found in multiple as well as single pregnancies also with extra uterine as well as intrauterine gestations. While accurate figures are

difficult to obtain the best available show that of all women having acute appendicitis about 2 per cent of them are pregnant

### ETIOLOGY

Attacks of primary acute inflammation during pregnancy are occasionally seen, but they are certainly not more frequent than at any other time or condition of life. If a careful history is taken practically every case will present evidence of previous trouble in the appendix with a resulting exacerbation if a pregnancy supervenes.

The organisms usually encountered are the streptococcus staphylococcus colon bacillus and sometimes the Welch bacillus. They play the same part here as in appendicitis at other times.

All pathological types are found the most frequent being the catarrhal suppurative ulcerative gangrenous and perforative. The latter is at once followed by peritonitis and other complications.

### SYMPTOMATOLOGY

The symptoms of appendicitis are so well known that little time will be devoted to them. It would be well to point out however that, while quite typical in early pregnancy, they are likely to be obscure misleading or masked in the later months. Abdominal pain nausea vomiting and a late rise in temperature occur as might be expected and sometimes a marked irritability of the bladder and rectum is present. The symptoms are those we associate with appendicitis but often atypical and difficult to elicit and interpret.

### DIAGNOSIS

As a rule diagnosis is easy in the early months but becomes increasingly difficult as term approaches. In the last few months it is always troublesome, is practically impossible during labor and is also likely to be difficult in the puerperium.

A rather common mistake is to confuse an early right sided ectopic gestation with appendicitis, or vice versa. This occurred in Case 6. Happily as operation is usually required in either case, the consequences are

not likely to be serious, if the procedure is not too long delayed.

Another mistake at any period of gestation is to consider the attack one of pyelitis. The result may be disastrous. The opposite mistake with the removal of a normal appendix is certainly the preferable of the two.

A most confusing factor will now be mentioned. Soon after the onset of an attack the sensitive uterus frequently responds to the irritation produced by neighboring inflammation by commencing to contract. The result of these contractions is to cause the attendant to consider the patient in labor and much valuable time may be lost before it becomes evident that all is not well. Even vomiting and a rise of temperature may not appear particularly significant at this time. This largely explains why an attack commencing during labor is practically never recognized.

In attempting to make a diagnosis every aid should be employed and of these the most important is a history of previous attacks. In view of the rarity of primary acute appendicitis during pregnancy this cannot be emphasized too strongly. If we then consider carefully the symptoms and whatever physical signs are present, and supplement this by a pelvic touch and unne examination, we have done about all that is possible.

Much of the aid usually obtained from a blood count is unavailable because of the leucocytosis which normally exists during pregnancy. If the count is well above 12,000 however and the polymorphonuclear ratio is markedly increased we have something of definite diagnostic value.

The last important point is to exclude as far as possible other sources of trouble.

The following conditions are the ones most frequently to be considered in making a differential diagnosis: (1) gall bladder disease, (2) right sided ectopic pregnancy, (3) right sided pyelitis or renal colic, (4) ovarian cyst with a twisted pedicle, (5) degenerating fibroid tumors, (6) intestinal obstruction, and more rarely, (7) diverticulitis and (8) mesenteric thrombosis.

## PROGNOSIS

Acute appendicitis has a higher morbidity and a greater mortality in the presence of a pregnancy than at other times, the prognosis largely depending on the rapidity with which a diagnosis is made and operation performed. As Babler has so aptly stated, "The mortality of appendicitis complicating pregnancy is the mortality of delay." The mortality at any period of pregnancy is practically nil if operation is performed upon an unruptured appendix, but, once perforation has taken place, it is about 40 per cent for the first 6 months and in the neighborhood of 60 per cent for the last 3. If abortion should occur the rate will be at least 10 per cent higher in each instance. Fairbairn quoted a series of 74 perforated cases, with 50 deaths, under various methods of treatment. Schmidt reported 486 perforated cases with a mortality rate of 50 per cent. So that we are undoubtedly dealing with one of the most dangerous complications of pregnancy.

When we consider the fetus it is evident that if an early operation is done, abortion will seldom take place. In the 9 cases previously reported this occurred in only one instance, and Myers sometime ago also reported 17 cases without disturbance of the ovum. Other writers have reported numerous similar instances. Once perforation is present, however, about 40 per cent of the pregnancies in the first 6 months will be lost, and the outlook is much darker in the last trimester. Perforation during the latter period will give a premature labor ratio of at least 90 per cent, only a rare case going to term if the mother is fortunate enough to survive. The writer believes that this last point is important to bear in mind, for he bases the treatment of these late perforated cases very largely on the fact that the woman will miscarry if the child is left in the uterus.

## PROPHYLAXIS

Before taking up the most interesting phase of this subject, namely treatment, let us stop for a moment to consider if anything can be done to prevent the occurrence of this serious complication of pregnancy. It is

with this in mind that the following recommendations are made:

- 1 The routine removal of the appendix, even when it appears normal, should be done during laparotomies performed for other conditions, whenever it is safe and practical to do so.

- 2 If a married woman has a diseased appendix, the offending organ should be removed before she becomes pregnant.

- 3 A pregnant woman with a history of previous trouble in the appendix should have appendectomy performed at the first appearance of symptomatology. The attending obstetrician during this period of observation should be ever on his guard in expectation of an acute attack.

## TREATMENT

Although the treatment is always surgical it differs markedly during various periods of gestation, so that it is best to consider each of these periods separately.

*Treatment during the first six months.* The operative procedure here does not differ essentially from that employed when a pregnancy is not present, as the uterus is not yet of sufficient size to interfere with access and drainage. Careful handling of the uterus is necessary and the modern tendency to avoid drainage whenever possible is highly desirable. Following operation, the patient should be deeply morphinized for several days. A right rectus incision gives good access, and the appendix should always be removed if practicable. If the condition of the patient is poor, drainage of an abscess if present may be all that can be done at the time, and, in such an instance, a secondary operation for the removal of the appendix may be necessary later. This should be postponed until considerable time has elapsed following delivery unless marked symptoms compel earlier intervention.

*Treatment during the seventh month.* At this period the conditions encountered determine the treatment to be used, and the judgment of the operator is all important. The size of the uterus, the position and accessibility of the appendix, the amount of pathology, must singly and collectively be



considered. As a rule the treatment is similar to the one just outlined although in certain cases because of the aforementioned conditions the procedure must be that reserved for the last 2 months.

*Treatment during the eighth and ninth months.* Until now the question has been largely a surgical one but at this time the obstetrical management of the case confronts us and several problems arise. The most important of these will be briefly discussed.

1. Should the pregnancy be terminated or left undisturbed? In discussing this problem it is well to recall that perforation and some degree of peritonitis are likely to be present when the abdomen is opened. If this is fortunately not so only one procedure is warranted namely to remove the appendix quickly and leave the pregnancy alone. In this type of case if premature labor ensues no harm will result provided the abdomen has been securely closed. With perforation and peritonitis present however the pregnancy can rarely be saved and labor will follow operation within a few days with disastrous results. Newly formed adhesions will be torn, drains displaced and widely spread and a sick patient further exhausted. It would be well to bear in mind also that the baby is toxic and if delivered at the time of operation is spared further toxæmia and the punishment of labor.

The answer to this first question is that in the presence of perforation the uterus should be emptied at the time of operation in the interest of both mother and child.

2. If termination of the pregnancy is decided upon should it be done from above or below? This question concerning the relative merits of supravaginal versus intravaginal delivery is not a difficult one. Three methods to accomplish the latter are available namely, vaginal cesarean section, accouchement force and induction of labor by the use of bags, bougies, etc. It is generally conceded today that vaginal cesarean section should seldom be done after the commencement of the eighth month for the technical difficulties are too great and the baby almost always is lost. The most important objection to this procedure in the present instance however, is based on the fact that it inflicts

a shocking bloody operation which must at once be followed by an abdominal one, either alone being considered sufficiently severe for a patient to withstand. Accouchement force has the same objection to a more marked degree and is now considered an obsolete procedure. The induction of labor by any method would not be indicated as this would mean more or less delay which is never permissible.

It is evident that none of the aforementioned methods can be used and that delivery must be accomplished from above.

3. What types of operation are available to open the uterus and what are the indications for each? If a marked peritonitis is present, with extensive involvement of the uterine wall a rapid Porro operation is the safest procedure offering the best chance for free drainage, the complete removal of infected tissue and ultimate hope of recovery.

The two flap low section must be considered whenever the uterine wall is involved provided the involvement is not too extensive and other conditions are suitable for its use. Unfortunately this is not often the case as there has seldom been sufficient labor to thin out the lower uterine segment and draw up the bladder. This method ranks next to the Porro operation for safety whenever it can be properly performed.

The classical section because of its simplicity is the method best adapted to most cases and unless performed in the presence of severe infection, will yield good results. Whenever this procedure is used it is advisable to close the uterus in layers and to peritonealize the incision as much as possible.

The writer suggests the following procedure at time of operation.

The abdomen should be opened by a liberal incision and unless definite evidence of the trouble is apparent the appendix site should be carefully approached during which time the uterus is protected by lap sponges. If an inflamed but as yet unruptured organ is encountered, it should be removed and the abdomen securely closed. At the first appearance of peritoneal involvement however further exploration should at once be stopped and the diseased area

carefully isolated with sponges, the operator's gloves changed, and all made ready to empty the uterus. If the peritonitis is extensive, with marked involvement of the uterine wall, the Porro operation should be performed. If the infection is less severe the low cesarean section is indicated provided other conditions permit. In the other cases, in which only slight uterine wall involvement exists, or is entirely absent the classical operation should be done.

Following delivery the uterus, if it has not been removed should be again protected and the appendix dealt with. The operation should be a rapid one and every effort made to avoid the spreading of infection as these two factors play an important role in the prognosis.

When drainage is necessary, it is essential that it be thorough. As a rule it is better not to use the abdominal incision for this purpose but to employ a stab wound in the right flank. Vaginal drainage is very satisfactory, particularly in conjunction with the above and should always be used after a Porro operation.

*Treatment during labor.* The possibility that it may become necessary to treat this condition at this time, is slight because the diagnosis is made with difficulty and in but few cases, so that little space will be devoted to treatment during labor. Treatment is essentially the same as that just outlined for the first trimester. If however examination shows delivery to be imminent, the birth must of necessity be from below. Following this we should not delay in performing a laparotomy, bearing in mind that the violent excursions of the uterus in all probability have caused the infection to become widespread.

*Treatment during the puerperium.* Appendicitis in the puerperium frequently is not diagnosed, but whenever operation is done, the technique of appendectomy as performed at other times is used. The writer believes that the following case is a good illustration.

M. L. age 38, entered the Methodist Episcopal Hospital February 5, 1927. Her history was negative except for occasional nausea and belching

of gas without apparent cause. After an uneventful confinement she was returned to bed in good condition. The day following delivery she vomited several times and complained of considerable abdominal pain which became worse during the next 5 days and was fairly well localized in the right lower quadrant. Because of the presence of pus cells in the urine and some tenderness along the course of the ureter the patient was treated for pyelitis. During this 5 day period the leucocytes remained at 1,000 with 83 per cent polymorpho-nuclears. A consultation was held at the end of the fifth day as the patient was getting worse. This disclosed the presence of an indefinite mass near McBurney's point and because of this and an increase of leucocytes to 16,600, polymorpho-nuclears 89 per cent a final diagnosis of acute appendicitis was made. Immediate operation revealed a large abscess and a gangrenous ruptured appendix with a hole at its base. After the appendix was removed, the abdomen was freely drained. The patient did well for 3 days when she died suddenly of a pulmonary embolus.

#### COMPLICATIONS

Complications occur to an extent which might be expected, but they are not more varied or more severe than those found after other cases of appendicitis. One exception to this, however, is that the incidence of pelvic phlebitis is much increased. The cause of death in Case 10 was an embolus probably originating from a pelvic phlebitis.

#### CONCLUSIONS

1. No reliable statistics are available to indicate how frequently appendicitis complicates pregnancy. It is known however, that about 2 per cent of women with acute appendicitis are pregnant.

2. About 80 per cent of the cases occur in the first 6 months, the disease being comparatively rare in the last trimester. It undoubtedly is more common in the puerperium than is generally supposed, but is frequently overlooked at this time.

3. Pregnancy reacts unfavorably on a diseased appendix. It always aggravates the existing pathology and is likely to precipitate an acute attack at any time. Primary attacks during pregnancy are quite rare.

4. The disease runs a rapid course, and perforation and peritonitis may be present in a few hours. This is especially true in the late months of pregnancy.

5 The diagnosis becomes increasingly difficult after the sixth month, this being especially true if uterine contractions are present. The leucocyte count does not furnish much aid because of the leucocytosis normally existing during pregnancy. In case of doubt operation should be performed.

6 The maternal prognosis is good if an early operation is performed but following perforation a mortality rate of 50 per cent is to be expected. In simple cases there is little danger of abortion but if perforation is present the uterus will empty itself in at least 50 per cent of the cases. The more advanced the pregnancy, the greater is the danger to mother and child.

7 Whenever possible the appendix should be removed during laparotomies performed for other conditions. When the organ is known to be diseased it should be removed before pregnancy occurs and if a pregnancy is already present at the first appearance of symptoms.

8 It is in the last trimester that several important problems have to be dealt with, and it is in order to meet these that cesarean section followed by appendectomy is advocated as the procedure which will give the best results.

9 The method to employ in emptying the uterus depends on the extent to which the

uterine wall is involved in the infectious process. When this is slight, the classical operation is indicated, but, if severe a choice must be made between a low section or the Porro operation.

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## DIVERTICULUM OF THE URINARY BLADDER

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**D**IVERTICULA of the bladder have long been recognized at autopsy, as shown in the writings of Albucasis (1) in the eleventh century, of Blasius (3) in 1677, and particularly of Morgagni in 1769. The very early writers designate them not as diverticula but as supernumerary bladders. This is noted in the writings of Brussiere, who mentions examples of double and triple bladder. Lambratti, Fannoni, and Malgatti allude to a four sac bladder. We believe Morgagni (21) was the first one to place diverticula on an anatomicopathological basis and to designate them diverticula. Herbst (11) and others credit this early work to Heister.

While the history of diverticula is a fairly long one from the archives of the pathologist, as a clinical entity it is really very brief. In fact one may unquestionably say that before the introduction of the cystoscope by Nitze their recognition was rare. In fact they were detected only when of such size as to project above the pubis. This also was mostly guess work. More often it was an accidental finding at operation, or found in the sanctum of the pathologist.

Durrieux (9) in 1901 was able to collect but 194 cases in the literature, and many of these were autopsy reports. Hyman (15) states that in the American literature there were only about 6 cases reported up to 1906. Young (26) in 1906 found 5 cases in the world's literature in which the sac had been excised. In 1912 Lerche (19) noted records of 14 cases of excision and his own made 15. The introduction of cystography in this period led to the recognition of many more cases. It was, however, the idea of contrast cystography as advanced by Hinman in 1919 that gave the greatest impetus to the study of diverticula. Our own interest in this subject dates back about 25 years. At that time while in charge of the autopsy work of a large hospital we noted vesical pouches in 5 to 7 per cent of our material. In this series most of our subjects were bodies advanced in years.

This being so we thought that age might be an etiological factor. This opinion we have subsequently modified.

In a previous contribution we have divided the history of ureteral stone into definite eras and this is a great aid in study. We shall therefore follow with diverticula of the bladder the suggestions of Durrieux who divides them into four eras: (1) the period of pathogenesis suggested by the writings of Morgagni and Houstet, (2) the stage of clinical study, covered by the work of Chopart, Civiali and Gallin, (3) the histological era and the formation of early theories regarding the presence or absence of bladder muscle, (4) the period of cystoscopy and surgical treatment, covering the epoch making contributions of Czerny and Nitze.

Most interesting study of this subject has been carried out by Blum (4) of Vienna, Durrieux of Paris, and still more recently in the excellent work of Mario Negri (22), one of the most progressive members of the modern French school of urology. The investigation of vesical diverticula and the solution of the problem is however fast becoming another diadem in the crown of those indefatigable spirits, the American urological surgeons. This is well shown in the splendid contributions of Herbst, Hinman, Hyman, Watson (25) and Rose (24).

## ETIOLOGY

Just what is a bladder diverticulum? In our own introduction to the subject almost 30 years ago, we heard the late Dr. Forbes speak of those herniated spots in the bladder sometimes called diverticula. Is this the correct solution of the problem of etiology? Much of the early work in this line was carried out by the German School, more particularly Engisch, Pagenstecher, and Wagner. These writers claimed that there were two types of diverticula, the congenital and the acquired. It was thought that the congenital diverticula contained all the layers of the true bladder.

The acquired it was said was composed of a wall of fibrous tissue and epithelium. This reasoning has not withstood attack. While these two types undoubtedly do occur, they are now known as true and false respectively.

Before mentioning briefly our own views we shall note the opinions held by prominent investigators.

Anschuetz (2) believes that there is a congenital weakening of the bladder and that the diverticula are of the pulsion type. Cabot (6) believes them to be pouches of congenital origin. Dav and Martin (8) are of the opinion that we have an embryological defect in the bladder plus an obstruction at the vesical neck. Englisch (10) mentions true and false diverticula, the true covering all the coats, the false being limited to the mucous membrane. Our own studies are quite in accord with this finding and we believe false diverticula are by far more common.

Hinman (14) believes that there is a condition in the bladder conducive to diverticula and that the weakened spot responds to the increased tension caused by obstruction. Lennander (18) cites a bladder diverticulum in a child of 21 months, apparently caused by an obstruction of a marked phimosis. Lurz (20) believes that diverticula are of the pulsion type and only the predisposition is congenital. Rose (24) in his recent studies believes that all diverticula are congenital to the extent that an unprotected or direct loose fibrous tissue pathway must exist through the bladder wall before herniation takes place. Watson (25) in his excellent studies has shown that there is a definite developmental basis for those diverticula in the region of the trigone.

In our own studies of over 50 cases we have been greatly impressed by the fact that in every instance in which a real diverticulum was found there has been a urethral or vesical obstruction of more or less degree over a period of years. It is claimed by some that this merely draws our attention to the sacs. This is certainly by no means true for the reason that diverticulitis is a sufficient cause of real symptoms.

We have seen diverticula occurring in almost every part of the bladder in autopsy material and in the clinic. These specimens

all presented a distinct defect in the bladder wall through which a herniation, incident to increased intravesical or extravescical tension had taken place.

#### INCIDENCE

An examination of the records of a large number of hospitals shows a wide variation in the incidence of bladder diverticula.

In one series there is a record of 2 per cent of diverticula noted in the cystoscopic reports. Another clinic reports 5 per cent and a service of considerable size reports about  $\frac{1}{2}$  of 1 per cent. In our own observations the clinical and postmortem records seem to agree quite well, namely, a percentage of from 5 to 7. Inquiries at the large gynecological clinics in which considerable cystoscopy is said to be done show that diverticula are seldom seen. We cannot refrain from saying that we believe most of the statistics as related to the female are incorrect. Our reason for doubting these gynecological observations is that we have seen it many times in the female. In addition to this we have repeatedly seen them passed by in the women's clinics. About 2½ per cent occur in the female bladder.

Of all bladder diverticula, Judd and Scholl (17) report 133 cases treated surgically in 10 years. Hyman (16) in 1923 estimated that about 600 cases had been treated to that date. In examining many cystoscopic reports the following is noted: a bladder pouch in which a ureteral catheter has been coiled. These pouches are not called diverticula, but often are all one hears of what is really a large diverticulum. Indeed many diverticula are called cellulæ by the observer and labeled as such.

Hyman in his search of the literature found that of 600 reported cases about 30 were in children under 10 years of age. We have seen 1 case in a boy of 5 years who was also suffering from spina bifida. Hinman reports 1 case in a child under 10 years. In Fisher's series of 48 cases, 6 were in children, 2 of whom were cured by operation. One was a child of 20 months. In the cases compiled by Englisch in 1907, 171 in all, 22 were under 10 years, the youngest being 8 days. One case has been reported in a fetus. It is interesting to note

that some of the cases of very young patients were used to substantiate the congenital origin of diverticula

In the records of 100 cases, 50 of which are our own, the following ages were noted

Years	No Cases
Under 10	5
10-20	1
20-30	6
30-40	11
40-50	30
50-60	41
60-70	2
70-90	2

The noteworthy fact about this table is that there seems a greater incidence between 40 and 50 than is generally recorded

In regard to sex, the observation of Rose, of fixation at the trigone in male and female bladders, is a definite factor in explaining a relatively greater frequency of diverticula in the female

#### LOCATION

The vast majority of bladder diverticula, in fact we may say 70 to 80 per cent, are located near the ureteral openings. We have, however, seen them in all parts of the bladder except the trigone. It has been said by some that diverticula located high up drain better and are more susceptible to treatment. This is very doubtful, as there does not seem to be any contractile power in these sacs which by the weight of their contents bar drainage. Infective and calculous formation seems to occur just as frequently when the sac is located in the dome as when it is on a lower plane.

Practically all diverticula are infected to a greater or less extent due to the presence of ammonia splitting bacteria

Single	Cases
Right wall—ureteral	33
Right wall—lateral	21
Left wall—ureteral	11
Left wall—high	9
Base	1
Dome	5
	80
Multiple	Cases
Bilateral ureteral	3
Bilateral lateral	5
Double base	2
Right ureteral and left lateral	7
Five or more sacs	3
	20

#### SYMPTOMS

Symptomatology is a very brief chapter in the study of bladder diverticula. We do not mean that this condition is not productive of symptoms, but that it is lacking in characteristic features.

Sooner or later all types of the condition produce symptoms and it is often the associated diverticulitis and peridiverticulitis which is responsible for this. The double voiding, in which the patient apparently empties the bladder and the desire is apparent again in a few moments, is the nearest to a typical symptom.

Another but by no means common assertion is that the patient feels a ball which seems to rise and fall in the pelvis.

We hear hematuria at times spoken of in conjunction with this disease. When bleeding occurs we believe it is due to trauma, stone, tumor, or tuberculosis and is not caused by the sac proper.

#### DIAGNOSIS

The diagnosis of bladder diverticula as a rule can be made by means of a careful cystoscopic examination. There are, however, some cases which will escape the eye of the most painstaking observer. The cystoscope, while it gives us the location of the sac, does not distinguish retention and non-retention types. In the presence of masses it may also be unreliable, the same may be said of prostatic hypertrophy.

Cystography gives us the most exact diagnosis possible. In simple cystography, as usually practiced, a 12 per cent sodium iodide solution is used. This salt however seems to be quite irritating and many are unable to retain it. Of late we have been using a 5 per cent solution of neosilvol which is much less irritating to the vesical mucosa. There seems to be an impression that simple cystography gives us an exact idea of the position, size, and contour of the diverticular sac. This is not quite true. In many cases upon opening the bladder area we find a much greater sac than we had reason to anticipate. Simple cystography apparently was first practiced by Lerche of Minnesota in 1912. Lateral cystograms give a better impression of the divertic-

ula on any particular side. The contrast between an anteroposterior picture and a lateral is often quite striking. We regret to say that our own lateral pictures have not been very successful.

#### PROGNOSIS

The outlook for these cases, treated surgically is good. We use this expression advisedly. The prognosis of the non retention type is naturally better than that of the retention. When the sacs are not over 2 or 3 in number and are fairly regular in outline the outlook is good. When the diverticula become numerous the possibilities of a cure are remote. However when complete recovery is not obtainable in practically all cases alleviation can be expected. The presence of a marked peridiverticulitis lessens the patient's chances greatly.

Again we must allude to renal drainage as with extensive kidney disease the prognosis is grave indeed.

#### TREATMENT

The means advocated for the relief of bladder diverticula may be palliative or radical. In this connection it is distinctly to be understood that these are both operative surgical procedures. Distinctly conservative nonoperative procedures accomplish nothing and must be disregarded.

One of the early operations, namely that of Pousson, in which the diverticulum is merely sutured is now an unsurgical procedure.

In many of these a preliminary treatment similar to that for prostatectomy must be carried out. The first radical operation for bladder diverticulum was practiced by Czerny (7) in 1896. The principal methods of radical treatment at present are the intravesical removal of Young and the combined intravesical and extravesical technique of Lower. It is our purpose in this paper to draw attention to all of the methods employed particularly those less radical in form. In this connection we have been quite successful with the technique suggested by J. S. Read (23). We believe those measures will be much more extensively practiced when they are more widely known. Since many of these cases

present a definite urinary obstruction, we must emphasize that this feature receives appropriate treatment before the diverticulum is considered. The preliminary case reports cover the forms of treatment usually indicated, from the extreme radical to the palliative form of procedure.

**CASE 1 (Fig 1)** J. L. D. age 52 white married was found to have large and small multiple diverticula of long duration with peridiverticulitis and a median bar.

This patient was operated upon in a nearby city for a prostatic hypertrophy 3 years ago. At that time he was regarded as a poor surgical risk. A two stage prostatectomy was done under local anesthesia. In spite of all precautions the patient was in a state of severe shock after both stages. The suprapubic incision remained open for 2 years.

The patient is a rather frail looking man who complains of frequency half hourly during the day and hourly at night. The amount of urine voided varies considerably. Urine is distinctly ammoniacal and very foul. A residual of 10 ounces is noted.

Cysto urethroscopy (Fig 1) shows a very prominent median bar. In the vicinity of each ureteral orifice there are several openings of diverticula varying in size. Over the dome and posterior aspect of the bladder several orifices are seen in all about 15. Through the cystoscope flaky pus could be seen emerging from several of the openings. In view of the general condition certainly no radical operation was permissible.

**Treatment.** The patient was placed at rest in bed for a couple of days, his bladder being irrigated night and morning with a 1 to 5,000 acriflavine solution. We had found this solution quite valuable in this class of cases. On the third day the patient was given a sacral injection of 30 cubic centimeters of 1 per cent novocain. Very liberal sections were then removed from the bladder neck by means of a Young punch. In spite of the utmost care considerable shock followed this minor procedure.

Following the operation the patient expressed very great relief. While there is slight cloudiness of the urine still present, he has no urgency or frequency. The patient voids every 3 hours during the day and once at night. He has also gained greatly in weight and strength. This case illustrates the improvement incident to removal of the urinary obstruction.

**CASE 2** A. M. D. white married age 60 was found to have bladder diverticula with great hypertrophy of the interureteral bar.

The patient is a fairly well nourished man but decidedly lacking in stamina. It appears that he was operated upon about a year ago for a supposed prostatic hypertrophy. From the reports we gather the gland was of the small fibrous type. He states that prior to his operation his chief trouble was frequency and urgency, a condition which still persists.



Fig. 1 Cystogram

Although he seems reluctant about admitting it there is quite a little dribbling. The urine is very cloudy and contains considerable pus. Examination shows about 4 ounces residual urine.

Cystoscopic examination shows a bladder somewhat trabeculated with a quite large diverticular orifice just external to each ureteral orifice. The vesical orifice looks quite good. The interureteral bar however shows marked hypertrophy; the bar seems to divide the bladder into an anterior and a posterior pouch. The whole trigone including the so-called Bell's muscle is slightly involved in the hypertrophic process.

Cystogram (Fig. 2). One would expect in a case such as this to find an almost hour glass appearance in the film. It however shows diverticula in the lateral wall as well as in the dome.

Treatment. This patient wanted relief without an operation. He was given a caudal anesthesia and was cystoscoped. A very large fulgurating tip (the Collings instrument) was inserted and a good sized section of the interureteral bar removed. After operation it was noted that while the sacs were still present there was a marked improvement in the drainage. Another point is that later pictures showed less retention in the pouches. In other words they were distinctly less retentive in type. The urine seems almost clear; he voids every three hours and once at night. The relief in this case has been considerable.

CASE 3. C. G. I. white, 51 years of age, married, native of Netherlands, had a bladder diverticulum and a stricture of the urethra.

This man reported complaining that there was at times difficulty in voiding. He also felt a sensation as if a ball were moving up and down in his pelvis.

Examination revealed a stricture of the urethra about 17 I. Examination of the bladder showed a very well congested trigone and a group of cellulites



Fig. 2 Cystogram

near the right ureteral orifice. These latter are apparently quite superficial. Near the left ureteral orifice there is an opening into which the ureteral catheter passes to its full extent. The vault of the bladder is apparently normal. Urine from both kidneys appears to be normal. We were unable to feel the ball in the abdomen which the patient complained of. However while the sodium iodide was being injected for the purpose of making the cystogram the patient stated he felt the ball increasing in size.

The cystogram (Fig. 3) was made with 12 per cent sodium iodide with air as the contrast. An examination of this plate shows quite clearly a very large retention diverticulum on the left side of the bladder.

Treatment. The patient was advised to have a series of ureteral dilatations until the calibre of the urethra admitted the passage of a 32 I. catheter and then to see that this calibre was maintained. The dilatations were readily accomplished. The diverticulum in this case did not seem to be causing any distress other than mental. The patient frankly came in and stated that the thing was getting on his nerve and that he wanted it removed.

Operation. Under local anesthesia the bladder was opened and the sac freed from the surrounding tissues to which it was adherent by a combined intravesical and extravesical manipulation. The sac was then packed with gauze as suggested by Fowler and removed extravesically. Relief is apparently complete at present.

CASE 4. J. A. Italian, married, age 52.

The patient states that he had always been well up to about 3 years ago when he began to experience slight difficulty in voiding. There was also slight vesical tenesmus and at times the desire to urinate



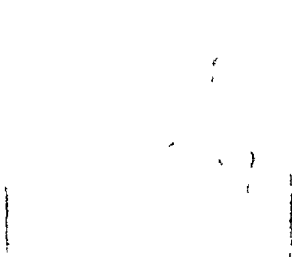


Fig. 3 Case 3

became very acute. A little later he noted that there was less irritability but was told by his doctor that the urine was loaded with pus. During the last year he has been bothered greatly with nocturia. He was operated on 6 months ago at a large western clinic and suprapubic prostatectomy was performed.

Three months after this operation he noted a fullness in the left side of the abdomen with an increase in frequency and a terminal hamaturia.

Examination by rectum shows large seminal vesicles which however can be emptied readily. The prostatic bed feel normal in size but is quite sensitive.

**Cysto-urethroscopy.** A McCarthy instrument enters readily. The fundus of the bladder appears normal. Upon the superior and lateral aspects of the vesical neck there are areas of bullous edema. In the trigone there is a mass which suggests a series of papillomata. This area extends well down into the prostatic urethra. In the lower prostatic area pus can be seen exuding everywhere. This mass acts in an obstructive manner to the urethral canal. Specimens taken from all parts show inflammatory tissue only. Near the left ureteral orifice there is a cavity which fully admits a large catheter (Fig. 4).

**Treatment.** All attempts to reduce the mass in the trigone and prostate were futile. Another opening was made in the suprapubic area and the inflammatory mass at the bladder neck thoroughly destroyed by the actual cautery. The orifice of the diverticulum at the left ureteral opening seemed quite large. The diverticulum was then drawn into the bladder and resected intravesically as advised by



Fig. 4 Case 4

Young. Convalescence was fairly good but the patient still complains at times of cloudy urine. Generally speaking the end result is good.

**CASE 2.** Mrs. G. S. age 63, widow, native of Poland was admitted to the service October 3, 1924 complaining of difficulty in voiding and suprapubic pain.

The family history could not be successfully elicited. Aside from measles during childhood and several attacks of tonsillitis the patient had always been well, having had no children or miscarriages. The patient denies having had any urinary diseases or infections but admits that she had a leucorrhoeal discharge for many years which she thought was only natural. The discharge apparently ceased about 6 months ago.

**Present illness.** For the past 2 years she has noticed a gradual diminution in the force of the urinary stream with slowly increasing dysuria. Urination is a very slow and tedious process. The patient feels that she is fully able to empty her bladder. There are at times however sudden spurts of urine after bladder evacuation has apparently been completed. Micturition takes place about every 2 hours with apparently no urgency or frequency. In the last two months pain has appeared at a point midway between the symphysis pubis and ensiform. This pain seems to bear no relation to the urinary act.

Urethral examination shows a stricture just within the urinary meatus which admits a 14 F. bulb on slight pressure. On attempting to withdraw same a distinct hang is noted near the external meatus. The urine contains a trace of albumin, few red cells and many pus cells. The urethra was gradually dilated until it would admit a No. 10 McCarthy cystoscope.



Fig 5 Cae 5

Cystoscopy The bladder mucosa on the vault and lateral aspects is anemic. The bladder seems to dilate well laterally but is contracted in the antero-posterior dimension. The vault is decidedly higher on the right than on the left. The ureteral orifices are normal in appearance apparently on the same level but a little farther apart than usual. Just to the outer side of the ureteral orifices there is an opening of a diverticulum.

The cystogram (Fig 5) shows the diverticula clearly. The diverticulum on the right is of the retention type the left only partially so. The urethral condition responded well to dilatation and the patient seemed relieved of all her symptoms. No change was noted in the sacs, and the patient desired no treatment for them.

This case seems to present in a rather striking manner a picture of congenital defect plus urinary obstruction as a cause of bladder diverticulum. We also feel that intrapelvic pressure has undoubtedly played its part as well.

CASE 6 J M white male age 52, native of Russia had a large right sided diverticulum with a small orifice, and a large left diverticulum with a large fibrous orifice.

The present complaint was incomplete evacuation of the bladder and burning pain in the perineum. The family and previous personal history has no bearing on the case. The patient admits several gonorrhoeal infections at from 18 to 26 years.

Examination reveals a well marked median bar and a diverticular orifice near the last ureteral opening. That on the right is small while that on the left is quite large. Another small orifice is noted low down on the left side.

Cystography confirms the findings above noted (Fig 6). In this case we resected the median bar with a Collings electrotome (nothing compares with



Fig 6 Cae 6

it for this purpose). Three months later the diverticulum on the right was resected. The sac on the left proved much more extensive than it is shown in the illustration. As it was found to have a large fibrous ring we hoped to accomplish something by resecting it. With the aid of the electric scalpel the ring was eradicated. The patient has seemed to be quite well since his recovery from the operation.

CASE 7 M G, white, male, single age 21, showed no diverticula.

This patient reported complaining of pain in the suprapubic area and cloudy urine, and stated that at times the pain ran up toward the right kidney. The pain apparently followed the course of the ureter.

The cystoscopic examination revealed pus in the bladder which evidently came from the prostate. The vault and lateral aspects of the bladder showed numerous cellulites in the region of the right ureter there appeared to be a narrow mouthed sac. On attempting to pass a catheter something solid was struck and the catheter passed no farther. A catheter was passed into the right ureter and a picture taken. This suggested possible stone in the diverticulum. A cystogram was then made and this seemed to clinch the diagnosis—however at operation the bladder was found quite normal and the mass was a large calcified area in the tip of the appendix.

#### SUMMARY

1 From our studies of bladder diverticula we feel sure that there are definite cases of congenital diverticula.

2 A congenital weak spot exists in the bladder in all cases.

- 3 Pulsion and pelvic adhesions provide the active means of producing the actual size
- 4 Medicinal treatment is of little value
- 5 Some cases can be cured by excision
- 6 In many cases cure cannot be effected but great relief may be secured by palliative procedures such as those advocated by Reid

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# SACRO-ILIAC SUBLUXATION AS A CAUSE OF BACKACHE

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SACRO ILIAC subluxation is a painful condition characterized by a definite displacement of the sacro iliac joint with injury or faulty posture as etiological factors. The condition is usually unilateral but may involve both joints. These cases are quite common but rarely diagnosed the complaint usually being mistaken for a contusion lumbago or sciatica. According to Goldthwaite (11) and Albee (1) a great majority of all backaches are due to the mechanical displacement of the sacrum and ilium.

The medical profession as a rule is woefully negligent upon the subject of backache and the patient usually receives symptomatic treatment only without the physician having a thorough understanding of the underlying pathology.

The subject is by no means new. It was described in 1851 by J. G. Fleming (8) of Glasgow and again by E. L. Bertherand (3) in 1857. In 1878 Charles T. Poore (20) reviewed the literature on the diseases of the sacro iliac joint. He referred to cases of relaxation due to the puerperal state and described in detail those cases due to injury.

Hirst (14) states that abnormal relaxation of pelvic joints is probably due to some pathological condition within the joint, usually an inflammatory process or new growth.

Jewett (15) mentions abnormal relaxation of the pelvic joints and gives the predisposing causes as osteomalacia, rickets, syphilis, tuberculosis, large fetal head, or faulty presentation.

Reynolds and Newell (21) state that there is occasionally a pathological mobility in the pelvic joints during pregnancy but gives no suggestions as to its cause or treatment.

Louis Cautin (4) deals exclusively with relaxation of pelvic joints during pregnancy.

Snelling (25) in 1870 described the condition as being specific to pregnancy and parturition and describes the sciatic pain which was present in his cases.

Irwin (10) in 1875 cited a case of relaxation of the sacro iliac synchondrosis during gestation.

J. C. Edwards and A. I. Kerr (6) in 1889 reported in detail a clearcut case of sacro iliac subluxation in a pregnant woman which came on suddenly when she arose quickly from a sitting position. A tight fitting support around the pelvis completely relieved the symptoms.

L. A. Lewis (16) in 1885 wrote a comprehensive article on the subject reporting in detail two cases although he did not find definite evidence of separation.

The real credit for bringing this most interesting subject before the medical profession belongs to J. L. Goldthwaite (11) who in 1903 published the results of his extensive work based on 300 hospital cases together with the results of an extensive anatomical research. He proved by the fresh dissection of bodies immediately at autopsy that motion exists and that the joint can be readily dislocated. The pelvis were dissected leaving all ligaments intact. The sacrum was then sawed through from the lumbar articulation to the coccyx and the sacro iliac articulation was studied. The degree of motion was determined by driving nails into the ilium near the articulation and into the promontory of the sacrum parallel to the first, then by raising the leg 50 degrees with the knee straight the ends of the nails separated about 3 millimeters. Dr. Goldthwaite described a plan of treatment which consisted of replacement of the bones by hyperextending the spine by placing a firm pillow under the hollow of the back or by allowing the patient to lie face down ward with legs supported upon one table and head and shoulders upon the other. After reduction he recommended a plaster jacket and immobilization for 4 weeks. He also devised a test for sacro iliac subluxation which consisted in having the patient stand on the foot of the affected side and flex the thigh with the leg extended, while the surgeon placed one

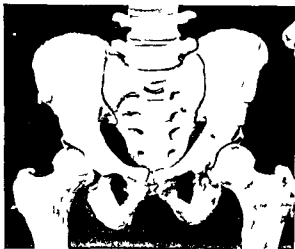


Fig 1 Anterior view of sacro iliac joint



Fig 2 Posterior view of sacro iliac joint

hand over the suspected joint and the other over the symphysis pubis. The latter will move with each motion of the leg which motion according to Goldthwaite always occurs in sacro iliac relaxation.

John Dunlop (5) gives the results obtained with 20 cases of subluxation of the sacro iliac joint by treatment with pelvic supports without any manipulation. All patients recovered in from 3 to 6 months.

Ralph Fitch (7) divides the cases into two types: first, those due to definite injury and second, those due to postural defects. He recommends tight pelvic supports and a pillow under the back and reports his results with 22 cases.

Albee (1) in 1909 noted the marked disagreement of the leading anatomists on the structure of the sacro iliac joint and dissected fifty cadavers. He concluded that the sacro iliac articulation has all of the elements of a joint that motion occurs in this joint especially in labor and displacement is common. Its affections are undoubtedly the cause of many obscure backaches and persistent sciaticas.

Pittfield (19) gives a comprehensive description of the anatomy of the sacro iliac joint and describes a new test for sacro iliac relaxation. He has the patient lie face downward on the bed and then places his hand under the patient and firmly presses the pubic bones, at the same time moving the leg

up and down. Prenatural mobility of the pubic joint caused by the relaxed sacro iliac joint is easily detected.

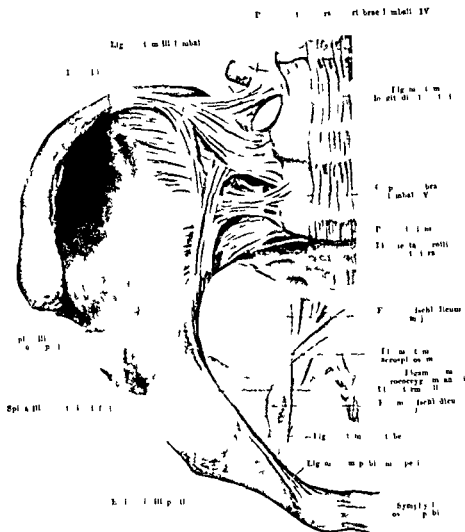
Young (27) calls attention to the value of Kernig's sign in diagnosing luxations. He describes a manipulation which consists of placing the patient on abdomen and making traction on the affected limb. He emphasizes the value of the after treatment and recommends exercise, massage, vibration and electricity to all of the ligaments around the joint.

Hatch (12) advocates reduction by flexing the hyperextended leg with the patient lying on the back.

Roth (24) in 1913 recognized that lordosis and trauma were important etiological factors and noted that subluxations predisposed tuberculosis.

Roberts (22) describes a case of marked traumatic dislocation of the sacro iliac joint with reduction by traction upon axilla and affected limb with the patient lying face downward on a table.

Hayden (13) emphasized the important effect of faulty postures in the production of subluxations. He states that the subluxation may be backward or forward and seldom upward or downward and that the backward displacement of the sacrum is most common. He recommends placing the patient on his back and flexing the thigh upon the abdomen with the knee extended to reduce the pos-





tional postures clearly illustrate this second type of case. The lumbar curve of the spine becomes obliterated and the ilium is consequently tilted forward at an abnormal angle with the sacrum giving the appearance of a flat back.

Characteristic of the first type is the sudden onset the so called stitch in the back. The patient will give a history of having missed a step while coming up the stairs or suddenly arising from a stooping position while picking something up or sudden heavy lifting or a sudden twist of the pelvis due to a fall. He is immediately seized with an excruciating pain in the affected sacro iliac joint and is unable to straighten his body. The lumbar curvature is frequently obliterated. It is quite evident that some mechanical derangement has occurred. Occasionally the condition may occur suddenly during sleep being caused by lying on the back and thus flattening the lumbar spine. This position necessarily strains the sacro iliac ligaments and muscles which soon become relaxed and a definite slipping of the bones occurs with the production of severe pain. The patient is awakened by backache of a very acute character which is usually relieved by stretching or hyperextending the spine.

In the second type of case the symptoms are of slow onset and referred pains do not develop for some little time. Faulty attitudes and postures are the etiological factors here, usually due to the patient's occupation although general lack of muscular tone is usually present. The sacro iliac ligaments are put upon a strain and dull aching pain which may be quite severe is produced. This pain is at first due to muscle fatigue from the attempt of nature to support the weakened joint. Later, however the pain is caused by the displacement of the sacrum and ilium. These postural defects tend to obliterate the lumbar curve and put great strain upon the ligaments and muscles. Examples of this type are seen in patients who are accustomed to sit with their lumbar curves thrown back while driving an automobile in firmen and in laundresses who have to bend over. The above posture produce a relaxation of the ligaments with a consequent subluxation of the joint.



Fig. 3. Frontal section of right sacro iliac joint (from "Spaltholz")

Although I have classified sacro iliac subluxations as belonging to two great classes acute which are traumatic and chronic which are postural there are other contributory factors which while not so important must be considered.

Normally motion exists in the sacro iliac joint during pregnancy but during parturition and menstruation the amount of motion is increased due to a normal relaxation of the pelvic joint which may become severe enough to produce a subluxation. Trauma and faulty posture at this time undoubtedly play an important etiological part. During the latter months of pregnancy there is a hyperextension of the spine due to lordosis. This position together with the physiological relaxation make the conditions ideal for the production of a subluxation.

Disorders such as infectious arthritis, hypertrophic arthritis and rheumatoid arthritis pre dispose to relaxation of the sacro iliac joint.

The articular surfaces of the joint are formed so as to make motion possible only in certain directions. The motion upon the transverse axis has its center at the lower portion of the sacro iliac articulation, through the second sacral vertebra. Because of the arrangements of the ligaments and the shape of the surfaces of the bones forming the joint, the motion must be a forward motion of the ilium at the top and backward at the lower end of the articulation, or vice versa unless the slipping be extreme.

The most commonly seen malposition has been described by most authors as a true back-





posture which is usually occupational. Occasionally the patient cannot recall any history of trauma or give a possible etiological factor.

The onset differs in the acute cases from that of the chronic postural. For example, the onset is sudden following arising from a stooping position, lifting misstep twisting of body usually laterally with the thigh abducted, or a blow over the sacro iliac joint. Excruciating pain comes on immediately, and the patient has difficulty in straightening up or in walking. Pain is associated with all motions or postures requiring movements of the sacral region such as sitting, getting up and down, stooping or even lying.

In the chronic cases, the onset is more gradual and may date from an injury or from prolonged faulty posture which is usually occupational. The backache is more apt to be generalized and involve both joints than in the acute type and is not of such a severe nature. He may frequently give a history of having used a pillow under the small of the back for the relief of pain. The pain is due both to the subluxation of the joint and to muscular fatigue from the attempt of nature to support the weakened joint.

Referred pain down the leg on the affected side is more common in the chronic cases than in the acute but develops at a later date. It is frequently present in the acute cases, however and may come on at once. This referred pain is due to a true sciatica produced by the mechanical irritation of the lumbosacral cord where it passes over the brim of the pelvis its point of passage being directly over the upper part of the sacro iliac joint where it is bound closely to the anterior ligaments of the joint and passes directly anteriorly down and outward to the lower pelvis and leg. The gluteal nerves also cross this joint anteriorly. In any displacement the edge of the bone is so exposed that pressure or stretching of the plexus can hardly be avoided. The severity of these referred pains may be great and may be referred to the thigh, hip, calf, or down the back of the leg, following the distribution of the sciatic nerve. The character of this pain is usually steady, being made worse by walking.



Fig. 7 Illustrating mechanical

Upon physical examination sometimes nothing can be seen on inspection of the sacral region, but usually there may be found

A marked prominence of the sacrum,

Rigidity of the spinal muscles due to spasm,

Obliteration of the lumbar curvature, due to anterior displacement of the ilium,

Lateral curvature of the spine away from the side affected,

There may be some swelling of the joint due to distention of fluid although this feature was not observed in our series,

Marked tenderness to pressure over the affected joint.

The patient usually assumes a stooping posture with the knees slightly flexed. Any motion which flexes the thigh while the knee is extended causes severe pain in the sacro iliac joint and down the thigh and leg. This is because flexion of the thigh with the knee extended tightens the hamstring muscles, and as the latter are attached to the tuber ischi, such motion will tilt the ilium forward upon the sacrum and by increasing the deformity produce an exacerbation of pain.

Abduction or outward rotation of the thigh does not cause pain, but extensive adduction



Fig. 8



Fig. 9



Fig. 10



Fig. 11



Fig. 12

Fig. 8 Photograph of patient before reduction. Note straight back.

Fig. 9 Same patient as in Figure 8 after reduction.

Fig. 10 Photograph showing deviation of spine.

Fig. 11 Same patient as in Figure 10 before reduction.

Fig. 12 Same patient as in Figure 10 after reduction.

or inward rotation of the thigh does produce pain as it tends to separate the sacro iliac articulation.

Compression of the crests of the ilia produces severe pain by causing separation of the sacrum and ilium.

The most important diagnostic sign is marked tenderness to pressure over the affected joint. Stooping is done with difficulty and pain and may be impossible unless the knees are flexed and the spasm of the hamstrings thus released.

Forward bending if attempted while standing with the knees straight is limited but is more free if the knees are flexed as when sitting. In the first position the hamstring muscles are made tense and pull upon the tuber ischii increasing the deformity and producing muscular spasms. However when the knees are flexed the muscles are relaxed and the spinal movements can be made more freely. Adduction with the thigh flexed produces pain. Also elevation of the leg with the

knee extended is limited due to spasm of the hamstrings.

In making a differential diagnosis consideration should be given to conditions of the sacro iliac joint hypertrophic arthritis chronic sciatica neurasthenia tuberculosis of the sacro iliac joint lumbago or so called muscular rheumatism and typhoid spine.

We find that in contusions the symptoms are more severe and persist longer than they do in a subluxation.

When the pelvis is firmly held all motions are much more free and less painful as the muscular pull upon the sacrum and ilium is relieved. This feature is important in differentiating a hypertrophic arthritis as in the latter the limitation of motion would be constant and would not be influenced by changes of position or support. In hypertrophic arthritis the decreased function together with the constant nerve irritation produces muscular atrophy which is not usually present in sacro iliac subluxations.



Fig. 13. Roentgenogram showing separation of joint

Chronic sciatica is, of course, only a symptom and is usually due to pressure or irritation of the sciatic nerve from some external source. However, it may be due to focal infection in rare instances, but according to Goldthwaite most cases of chronic sciatica are due to sacro iliac subluxations.

Neurasthenia in relation to backache in the great majority of cases should not be considered as it is usually an excuse for our inability to make a diagnosis. I have fresh in my mind a case of tuberculosis of the sacro iliac joint with associated sciatica which was diagnosed as neurasthenia until a large abscess formed.

Tuberculosis of the sacro iliac joint while rare is much more common than is generally supposed. It is very apt to be mistaken for a relaxation of the sacro iliac joint as the symptoms are similar. However, in tuberculosis the onset is insidious, the pain is of a dull aching character, worse at night, and more severe upon walking. Abscess formation usually occurs early and the changes can usually be seen early by the roentgenogram. General debilitating symptoms, with atrophy of the affected leg, occur early. Aspiration of the abscess, if present, will often show the organisms, or guinea pig inoculation will reveal the cause.

Most cases of lumbago, according to Magnuson, are subluxations of the sacro iliac joint. There are, however, certain cases of a



Fig. 14. Specimen showing relation of sacral plexus to sacro iliac joint

true myalgia affecting the lumbar muscles which are of an infective nature. The pain is higher and extends across the back, with marked tenderness of the lumbar muscles but not over the sacro iliac joints. The patient complains of a stiff painful back which is relieved by sitting or lying down. Upon arising he has difficulty in straightening the body.

Typhoid spines are sometimes due to subluxations, long rest in bed with subsequent relaxation of the ligaments and muscles, predisposing to the condition. However, the history of typhoid and the roentgenogram should make the diagnosis clear.

As strange as it may seem, the X ray offers little help in the diagnosis, positive findings being secured in only 7 out of 300 of Paul Magnuson's series and in only three cases of my series.

#### TREATMENT

The principle of the correct treatment is to restore the normal relations between the sacrum and ilium and to maintain them by suitable support. The reduction of the subluxation should be accomplished at once. Remembering the pathological process, which consists of a definite displacement forward

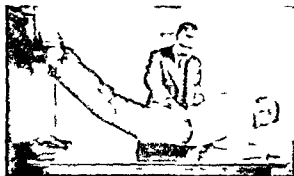


Fig. 1. Photograph illustrating manipulation of patient

of the ilium from the sacrum at the upper part of the joint produced by extreme hyperextension of the spine together with the strong muscular pull on the anterior part of the ilium it is readily seen that these two forces acting in opposite directions at the same time produce the forward displacement of the ilium at the upper part of the joint. The position is maintained largely by the psoas and the pull of the hamstrings on the tuber ischium which tends to rotate the ilium forward. The treatment should be based on principles which take into consideration the pathology that exists. Gunn's rule which is to place the extremity in the position it occupied at the time of the dislocation and reverse the force is applicable here the same as in any other case of dislocated joint and I will describe in detail a maneuver based on this rule which I believe to be original as a thorough search of the literature does not reveal any similar manipulation.

The patient is placed on the table face downward his weight being supported by the elbows and abdomen and his hands grasping the edge of the table securely. The surgeon while standing on a box near the feet of the patient firmly grasps his ankles and lifts his body clear of the table the body being supported above by the elbows alone. It is held in this manner for several minutes with the legs in abduction strong steady traction being made on the affected leg while an assistant makes firm pressure over the sacrum. The body should be lifted up and down while the traction is being made. There is usually sudden marked relief as the bones slip into place and the lumbar curvature is in most

instances restored at once. The mechanism is as follows. In lifting the patient's body by the ankles we are hyperextending the spine and thus relaxing the strong posterior sacroiliac ligaments and also relieving the joint from the pull of the hamstrings. The abduction relieves the supporting action of the psoas muscles. In other words, we are placing the joint in the position it occupied at the time of displacement which is hyperextension. The strong pull upon the leg of the affected side unlocks the joint by increasing the deformity due to the action of the extensor quadriceps muscles especially the rectus femoris sartorius and iliacus which exert a downward and outward pull upon the upper anterior part of the ilium thus increasing its separation from the sacrum and at the same time relaxing the pull from the hamstrings. Reversing the force occurs when the weight of the body drags the spine forward and favors replacement of the ilium by forcing the sacrum forward. This process is aided by pressure being made over the sacrum by an assistant and by the steady traction upon the affected limb which as was noted also tends to unlock or separate the joint. It can be readily seen that the dragging position of the suspended body together with traction on the affected side which relaxes the joint and firm pressure over the sacrum will tend to replace the bone thus fulfilling Gunn's rule. After replacement a firm support of adhesive tape is passed behind from in front of one great trochanter to the other. It must be remembered that it is essential to place the support low well down on the buttocks below the level of the trochanters as any lateral pressure above this point tends to separate the joint and produce great pain. The strap should extend from the anterior part of the ilium on one side to a similar point upon the other side and should cover the buttock and lower lumbar spine below the trochanter. I always put a firm pad of cotton or felt over the sacrum so that pressure is maintained on it at all times. This dressing should be re-applied in about 6 days. The patient should be put to bed for one week if the displacement is acute and a small firm pillow so placed as to maintain the lumbar curvature and keep any strain off the injured ligaments.

There is no single manipulation in surgery that gives more immediately spectacular results. A patient is seen suffering excruciating pain, the lumbar curve is obliterated, and he is scarcely able to stand. After the manipulation in the great majority of cases, he obtains immediate relief and feels practically as good as before. Untreated, these patients suffer indefinitely and inflammation frequently develops in the affected joint. These are the patients with chronic sciatica, lumbago, and muscular rheumatism that make the rounds of the physicians unsuccessfully and finally end up with osteopaths or chiropractors. In all cases I recommend that a supporting belt with a firm sacral pad lying at the front, be worn low down on the pelvis, the upper part of the belt always being below the iliac crests. The trouble with the ordinary sacro iliac belt is that it is made to be worn too high instead of low down on the pelvis at the level of the great trochanters. If the belt is too high pressure is exerted against the crests of the ilium and the separation of the bones increased and the purpose of the belt is defeated whereas if the belt is low the sacro iliac joint is compressed and supported. These supports are to be worn for 6 months and can be removed; it might be provided a small pillow be kept beneath the lumbar spine.

In the great majority of the acute cases this is all the treatment that is necessary. The patient should be cautioned against slipping, stooping with the knees stiff, sudden twisting or running as recurrences are frequent within the first 6 months. If there is no recurrence within that time, it is safe to assume that the joint has been restored to its normal condition.

Occasionally, and especially if the condition had existed more than one week, manipulation and support occasionally fail to effect an immediate cure, the reason being that an inflammatory process has already been set up in the ligaments or joint. Recovery will not take place until this inflammation subsides, and I know of nothing better to hasten the disappearance of the inflammation than diathermy given daily for about 24 treatments. This together with rest in bed and proper support will cure practically all of the acute

cases. The sciatica which occasionally complicates the subluxations usually subsides rapidly after replacement of the bones, support, and rest in bed. However diathermy along the course of the nerve has a most beneficial effect.

The treatment of the chronic cases due to faulty posture must have a somewhat different management. As a true relaxation exists, the bones should be replaced by the manipulation and the patient securely strapped with adhesive. In addition to the subluxation we have also an inflammation of the joint either one or both to deal with. The patient should be kept in bed for from 2 to 4 weeks with a small firm pillow beneath his lumbar spine. If the pain persists or if true sciatica is present, Buck's extension on the affected side will hasten recovery by relaxing the muscles and ligaments and immobilizing the extremity. I have occasionally injected the sciatic nerve with ice cold normal salt solution with prompt disappearance of the pain in the leg. This procedure however is rarely necessary. A plaster of Paris spica cast put on immediately after the reduction and kept on for from 2 to 4 weeks is a very satisfactory treatment as the immobilization allows the inflamed ligaments to heal. All pain usually disappears within several days after either the Buck's extension or the cast.

Where inflammation or infection of the joint is present following a chronic subluxation, there is reason to believe that focal infection plays an important role in prolonging the disability. All abscessed teeth and infected tonsils should be removed. I have two cases in mind in which recovery took place only after the removal of some gangrenous hemorrhoids. The entire general system should be toned up so as to afford all possible aid to the weakened ligaments and joints.

There are some cases of repeated recurrent subluxations which will fail to respond to the above treatment and immobilization of the joint by open operation with ivory pegs as recommended by Magnuson, or the bone in lav as done by Albee offers the best chance of a permanent cure.

Table I gives the results in my series of 80 cases.

## TABLE I RESULTS

	No
Total number treated	4
Acute cases—treated by manipulation strapping rest in bed for 1 week	65
Relieved	65
Complete permanent relief	50
Complete relief but recurrence in 6 months	15
Recurrence—once only	4
Recurrence—twice or more	19
No relief obtained	0
Improved but not cured	2
Chronic cases	15
Complete permanent relief following manipu- lation alone	5
Benefited but symptom not immediately relieved	9
Complete permanent relief following manipulation and Buck extension immobilization and dia- thermy	4
Relieved by manipulation and immobilization complete recovery following hemorrhoidectomy	2
Relieved by treatment complete recovery follow- ing tonsillectomy	2
Unimproved	2
Cases treated by manipulation alone	10
Relieved at once	10
Recurrence	1
Cases treated by manipulation and strapping with out rest in bed	0
Relieved at once	20
Recurrences	2

RESULTS OF ANATOMICAL RESEARCH PER-  
FORMED ON THIRTY SPECIMENS

Realizing that a great deal of uncertainty exists in regard to the structure and function of the sacro iliac joint we made a careful dissection of thirty specimens with the view of ascertaining the true anatomy and physiology of the joints. This work was carried on at the Anatomical Laboratories of Northwestern University.

The observations made were as follows: the sacro iliac joint is a true joint possessing synovial membrane which is much thicker on the sacral side synovial fluid and a weak capsule. Motion was elicited in every specimen and varied from 1 millimeter to 3 millimeters. In our cadavers in variance with the statements of other writers we found that the sacrum was fixed and did not move at all. The motion consisted of rotation both forward and backward of the ilium on the sacrum mainly at the upper part of the joint. We were able to produce definite slippings of the joint which consisted most frequently of an anterior displacement of the ilium on the sacrum. Definite locking occurred by forcing the ilium forward and downward which condition was relieved

by further separation of the joint. We were not able to produce any permanent displacement posteriorly of the ilium on the sacrum although the ilium was displaced posteriorly in every case from 0.5 to 3 millimeters when the thighs were flexed on the abdomen. We observed that the powerful psoas muscle acted as a brace to maintain the strength of the sacro iliac joint and that it was only after abducting the thigh slightly and thus relaxing the psoas muscle that we were able to produce appreciable motion anteriorly in the sacro iliac joint. Motion was demonstrated by driving a nail into the promontory of the sacrum another in the sacrum close to the joint and another in the ilium close to the joint all being in a straight line. By flexing the thigh on the abdomen the nail driven into the ilium separated from the line of the other nails from 0.5 to 3 millimeters and upon hyperextending the spine and the thigh thus causing the extensor muscles to pull on the ilium the nail in the ilium separated from the straight line from 0.5 to 3 millimeters in the different specimen. The degree of motion was increased by abducting the thigh and thus relieving the support of the psoas muscle. This procedure definitely showed motion to exist in the joints normally both anteriorly and posteriorly.

Upon dissection of a locked joint it was found that the locking was due to one or more of the rounded projections becoming impinged in a corresponding cavity of the opposite bone. The displacement appeared to be at the upper part of the joint and because of the ilium being pulled forward the appearance of a flat back resulted.

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## SPINAL ANÆSTHESIA

### A REPORT OF THREE HUNDRED AND NINETY TWO CASES

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IN reporting this series of 392 spinal anæsthesias, performed at the United States Naval Hospital, League Island, Pennsylvania, we do not wish to put forth the opinion that this form of anæsthesia is ideal. The question of its safety is debatable. It does not invariably produce analgesia, it does not always last long enough to complete prolonged operations, it is not without exception regarded by patients as pleasant to take, it is usually accompanied by a fall of blood pressure, often by nausea and vomiting, and sometimes by alarming visomotor and respiratory collapse. Many surgeons regard spinal anæsthesia as unsafe and unreliable.

Having enumerated some of the conspicuous bad features of spinal anæsthesia, we are prepared to make some frank comments, based on our limited personal experience.

An anæsthetic should be safe, never fail to produce anæsthesia, should be pleasant to

take, give satisfactory relaxations, and be free of untoward after effects.

There is no anæsthetic known which fulfills all these ideals. Ether is generally regarded as a safe and satisfactory anæsthetic. Ether has stood the acid test of time, it is almost fool proof. Nitrous oxide and ethylene are excellent anæsthetics, but they do not produce satisfactory relaxation unless combined with local anæsthesia. There is a tendency at the present time toward local anæsthesia. There is a reason. In fact there are several reasons. A local anæsthetic is safe, produces excellent relaxation, is not very unpleasant to take if expertly administered, and is at least quite as free from untoward after effects as are general anæsthetics. It was thought that local anæsthesia would eliminate pulmonary complications, but this hope has not been realized. We see post-operative pneumonia and pulmonary embolism following local anæsthesia. Patients suffering from acute and chronic respiratory



infections frequently come to us requiring immediate operation. Such cases undoubtedly run less risk of postoperative pneumonia and pulmonary abscess if a local or spinal anesthetic is used. No matter what the anesthetic may be the patient will probably perspire freely during the operation and it is my firm conviction that at least some postoperative pneumonias are produced by chilling of the patient either on his trip back to bed or after he arrives there.

If the patient's pajamas need to be changed care should be taken to prevent chilling during the act. The ventilation of wards and private rooms will also bear watching. A headache from insufficient ventilation is preferable to a headache from too much ventilation. The old fashioned draught is just as potent as it was in the days of yore.

Pulmonary embolism happens more frequently than statistics indicate. Many so called postoperative pneumonias are really instances of embolism with infarction. Fatal or near fatal cases are the ones generally recognized. When we recall that a clot in the venous circulation is carried to the right heart and then directly to the lungs it is reasonable to suppose that small clots frequently lodge in the smaller branches of the pulmonary artery and produce symptoms which pass muster as bronchitis and pneumonia. There is no convincing proof that spinal and local anesthesia has lessened the frequency of pulmonary embolism and thrombosis.

In this series of spinal anesthetics we had two alarmingly severe reactions but no deaths. In both instances the injections were made in the eleventh thoracic interspace. In one case the patient appeared to be dead. He was pulseless and breathless. When intravenous saline was administered it was necessary to expose his vein by dissection. The vein was cut to permit the introduction of a cannula. During the dissection for the vein and after the vein was cut, there was not a drop of blood in evidence. After the patient had been given about 300 cubic centimeters of salt solution (containing 0.1 per cent adrenalin) his pulse became perceptible and his respirations—at

first slow and irregular—returned. When the transfusion (1000 cubic centimeters) was completed his pulse, respiration and blood pressure had returned approximately to normal. Less than 3 minutes elapsed from the time this patient went into collapse until the intravenous salt solution was started. This patient also received 1/75 grain of atropine hypodermically. Atropine is a vasomotor stimulant, and if absorbed might be expected to be of value in vasomotor collapse.

Mild reactions were too numerous to enumerate. The average drop in blood pressure for the series was 18 points systolic and 15 points diastolic. The pulse rate was frequently, but not as a rule markedly decreased. Many patients showed pallor, nausea and vomiting. We treat these mild reactions by placing gauze wrung out in ice water over the forehead and by inhalations of ammonia. We have had no severe reactions when the injection was made in or below the second lumbar interspace.

In 10 cases adequate and satisfactory anesthesia was not obtained in 14 cases perfect anesthesia was obtained for approximately 1 hour but it was necessary to supplement spinal with local or general anesthesia to complete prolonged operations.

Failure to obtain anesthesia is probably due in large part to faulty technique. The full amount of the local anesthetic not being introduced into the subarachnoid space. In intravenous injections the needle may obtain blood but fluid injected may go into the cellular tissue outside the vein so, also in intrathecal rachianesthesia the needle may obtain liquor spinalis but the anesthetic when injected may not all find its way through the meninges but may be discharged into the cellular tissue surrounding the theca or some of the solution may leak through the opening. Therefore with a small bore needle properly introduced and with sufficient dosage of a potent local anesthetic anesthesia should invariably be produced.

Another cause for failure is over sterilization of the anesthetic.

Given properly and in sufficient dosage the local anesthetic should be responsible for few failures. As our experience increases our

failures decrease. We formerly gave 1 grain of novocain for each 100 pounds of body weight. We now give 2 grains to adults irrespective of age, weight, or blood pressure.

One of the most commendable features of spinal anesthesia is the relaxation obtained. In abdominal surgery relaxation and success go hand in hand. Relaxation makes for better exposure. When relaxed the patient breathes quietly. There are no exaggerated excursions of the diaphragm, or increased intra-abdominal pressure with consequent bobbing about of intestines. We obtain a "silent belly," and thus facilitates operative maneuvers and enables the surgeon to work skilfully and speedily. We have noticed in extensive intestinal resections, resections of the stomach and in gall bladder operations that shock is minimized by the use of spinal anesthesia.

The late untoward results of spinal anesthesia have been greatly exaggerated. Patients sometimes complain of severe headache after they return from the operating room. If the character of the operation permits the patient to take medicine by mouth we administer 10 grains of aspirin, and sometimes in addition a cupful of black coffee. Otherwise we may resort to morphine. In one patient an internal strabismus developed 3 days after operation persisted for several weeks, and completely disappeared. About the same time an internal strabismus was observed in one of the medical wards following a simple spinal tap performed for diagnostic examination. The dangers of spinal anesthesia, in our opinion are immediate, the fear of late complications—especially paralysis—may be regarded as a superstitious phobia. In making this statement we assume that the anæsthetic agent is not irritating to the cord or meninges, and the technique of administration beyond reproach.

Spinal anesthesia usually lasts about 1 hour and 15 minutes, sometimes less (about 45 minutes), and sometimes considerably longer (about 2½ hours). If the operation is expected to last more than an hour we should plan to supplement the spinal by local or general anesthesia.

One of the contra-indications of spinal anesthesia is supposed to be low blood pres-

sure. Most of our patients were young men, but nevertheless not uniformly good operative risks. The average blood pressure was 128 systolic and 80 diastolic. We have frequently administered spinal anesthesia to patients with systolic blood pressures ranging between 90 to 100. It seems safe to accept a systolic blood pressure as low as 100 for spinal anesthesia, but in the present state of our knowledge and experience this should be the low limit. Some other form of anesthesia is advised for patients with a systolic blood pressure lower than 100.

Spinal anesthesia should not be used routinely on all patients. No form of anesthesia should be used routinely. If we understand how to use spinal anesthesia, and bear in mind its limitations we have at our command an excellent form of anesthesia suitable for a large number of patients. Spinal anesthesia was first used in this hospital in June 1924, and since then to February 1, 1927, 1,428 operations were performed either by the writer or his assistants. Spinal anesthesia (unsupplemented) was used in 368 spinal nitrous oxide and ether, 16 spinal and local, 8 local (procaine), 488 caudal, 153, local and nitrous oxide, 29, ether and nitrous oxide, 221, ether, 138, caudal and nitrous oxide, 7.

In the Naval and Military Service and in isolated locations where there is a lack of capable assistants, the surgeon can employ this form of anesthesia and thereby have his most valuable assistant help him with the operation instead of functioning as the anesthetist. However someone should be at the head of the table to cheer the patient, give him a word of encouragement, or engage him in conversation. The patient's general condition should be watched by this assistant, who can also administer appropriate treatment including intravenous salt solution and adrenalin, as indicated. We do not believe in fussing with patients under spinal anesthesia. We do not ask them how they feel every few minutes nor do we note their blood pressure every so often. We determine the blood pressure before and after the injection, and again only when the patient shows symptoms of collapse. We endeavor to

create an air of genial confidence. We try to raise the patient's morale by our words and actions. Spinal and local anæsthesia work best mixed with psychology.

For operations in the upper abdomen we make the injection between the eleventh and twelfth thoracic vertebrae and for the lower abdomen between the second and third, or third and fourth lumbar vertebrae. We have practically abandoned the high injections and now use spinal anæsthesia only for operations on the lower half of the body. Sometimes the lumbar injection gives anæsthesia throughout the abdomen.

Our technique for the administration of spinal anæsthesia is as follows:

- 1 Two grains of powdered novocain are placed in a medicine glass or beaker, the top of the container covered with gauze and placed in the autoclave for eight minutes under 15 lbs pressure.

- 2 The patient who has received a preliminary hypodermic injection of morphine and atropine is placed in the sitting posture if his condition permits over the side of the table and the site of the injection painted with tincture of iodine and then with alcohol.

- 3 An 18 gauge nickelloid spinal needle is introduced in the center line between the second and third or third and fourth lumbar spines and about 8 cubic centimeters of spinal fluid collected in the beaker containing the sterilized novocain. The stylet is replaced in the bore of the needle to prevent further escape of spinal fluid while 3 drops of adrenalin are mixed in the beaker with the spinal fluid and novocain. When the novocain is completely dissolved the contents of the beaker are drawn into a 10 cubic centimeter Luer syringe the stylet is removed from the needle and the contents of the syringe are slowly injected.

- 4 The needle is withdrawn the site of the puncture touched with collodion, and the patient placed in the recumbent posture with the head slightly elevated.

The patient at first finds his legs heavy when he attempts to raise them and when this sign appears, we can feel fairly certain satisfactory anæsthesia will be obtained. Anæsthesia usually promptly follows the injection but the operation should not be started for at least 15 minutes after the injection is given.

We do not lower the patient's head as the solution injected is heavier than plain spinal fluid. After the lapse of 15 or 20 minutes when anæsthesia has been effected it appears to make no great difference whether the patient's head is raised or lowered. We have operated with the patient in the Trendelenburg position. We wish to repeat, however, that the patient's head should be kept slightly raised until anæsthesia is obtained. A conscious patient lying on his back is most comfortable and can breathe easier with his head resting on a small pillow.

- 1 Spinal anæsthesia does not fulfill all our ideal requirements.

- 2 It produces excellent relaxation.

- 3 The intrathecal injection of 2 grains of novocain dissolved in spinal fluid failed to produce anæsthesia in 25 per cent of our cases.

- 4 Spinal anæsthesia cannot be relied upon for long operations unless it is supplemented with local or some form of general anæsthesia.

- 5 Novocain spinal anæsthesia is safe provided the injection is made no higher than the second lumbar interspace.

- 6 We should constantly remember that patients under spinal anæsthesia are awake and are therefore susceptible to suggestion.

THE LOCAL USE OF ETHER IN GYNECOLOGY<sup>1</sup>

BY GORCL DI TARNOWSKY M.D. F.A.C.S. CHICAGO

FOUR years ago next month I presented before the fellows of this society my experience in the use of ether as a method of treatment in peritonitis and allied diseases. At that time, while I had had considerable experience in the local use of ether in infections I had not had enough gynecological cases to warrant my presenting that part of the subject to you. I want tonight to report the local use of ether in two gynecological conditions chronic endocervicitis and therapeutic abortion.

I have had the opportunity of treating ten such cases. The age of the patients varied between 18 and 44 years. Two of the patients were married in para and in para four were married and had never been pregnant and four were unmarried. The duration of the endocervicitis varied between a few months and 4 years. Two of the ten had lacerated cervixes which were repaired in addition to the local treatment. I used ether in these conditions because I was confident that if we could find some solution which was a stimulant but which could not produce any deteriorating effects on function we might show a step in advance in the treatment of chronic endocervicitis or cervicitis. The method advocated is comparatively simple. The whole procedure can be carried out in the office. If you have an assistant or a nurse it makes it a little easier but it is not necessary. The only instruments needed are a bivalve speculum, an ordinary dressing forceps, a tenaculum, a 20 cubic centimeter glass Luer syringe and some 12 or 14 gauge rubber catheters. The patient is placed on the gynecological table and the bivalve speculum introduced. The cervix is hooked with the tenaculum to steady it. The tip of the catheter is grasped with the dressing forceps and under guidance of the eye is pushed into the cervical canal for 1 1/2 to 2 inches. After this is done the tenaculum and dressing forceps are removed and an ordinary tampon inserted. I prefer cotton to any other mate-

rial because it absorbs the few drops of ether liquid which will drop back into the vagina. The Luer syringe is filled with 20 cubic centimeters of ether which is injected through the catheter fairly slowly. The patient who receives approximately 20 cubic centimeters complains of a sensation of cold followed immediately afterward by a sensation of extreme warmth but she does not complain of severe pain.

In none of the ten cases was there any severe reaction. The object of the cotton tampon is to prevent the dropping of the few drops of liquid ether into the vagina which would be painful. Consequently by the holding of the tampon tight against the cervix pressure is maintained. Those of you who were here 4 years ago will remember my stating that the action of ether was the same as that of a vapor. Ten seconds after it is put into the peritoneum it acts as a vapor under tension. Therefore a tampon placed against the cervix has this double action, it prevents the dropping of ether into the cervix, and permits the vaporization to be more thorough. Following the treatment we wait 5 minutes and then remove the tampon. The patient leaves the office 5 or 10 minutes later. The treatments are repeated twice a week. It goes without saying that in cases with lacerations and in chronic enlargement of the Bartholin gland treatment should be surgical prior to that of ether.

The results have been extremely gratifying. Perhaps I could mention one typical case. A young woman of 21 years married 4 years, not pregnant. On examination I found a marked retroversion of the uterus and a typical picture of an oozing cervix. There was thick, tenacious mucus filling the whole upper vaginal vault. After eight treatments, the endocervicitis had improved 75 per cent. I did a round ligament shortening and the patient left the hospital after twelve treatments. I followed that patient for 1 1/2 years. She reported to me every 3 months for

<sup>1</sup>Read before the Chicago Gynecological Society December 27 1926.

examination I consider her absolutely cured. The same is true of the two patients with lacerated cervixes which I repaired and afterward treated locally. They are absolutely well, do not complain of leucorrhœa and no longer wear protectors. I have no hesitancy in recommending this as a simple effective office treatment for endocervicitis.

The second condition in which I have used ether locally and I hesitate somewhat to present this because it might be misunderstood is for the production of therapeutic abortion. In the past 5 years I have had three occasions to produce therapeutic abortion. The first was in a young married woman a Polish refugee 7 years of age who was sent to me because of tuberculosis of the left upper lobe of the lung. She had not only a tuberculosis but also a pleurisy with effusion. With the same treatment which I use for endocervicitis I introduced the catheter 4 inches instead of 2 and injected 1 dram of ether into the uterine cavity. The same sensation of cold followed however in this case by a sensation of heat and immediate cramps occurred. Within 2 minutes ether vapor mixed with a few drops of blood issued through the cervical canal. I left the patient on the table for 5 minutes, at the end of which time the cramps had ceased. She was taken home and 18 hours later passed a spontaneous product of conception. That was my first case. A year and a half later an Italian woman also tuberculous 2½ months pregnant was sent to me and I used the same treatment. In this case I did not succeed in passing the soft rubber catheter. She had been badly lacerated in the two previous pregnancies and I could not pass the catheter into the orifice. Fortunately I had

a No. 12 Coude hard catheter and by holding it with its tip turned anteriorly it passed into the uterine canal without any difficulty. Again I injected a dram of ether. This patient was a Sicilian highly excitable and she created quite a little disturbance in the office for about 2 minutes. The cramps apparently were excessive. She confessed afterward that the pain was not excessive but that she was scared. Those of you who know the southern Italians can understand how they cry out at apparently nothing. She quieted down and was taken home. Twelve hours later she telephoned me that she had expelled a product of conception.

The third case was a Russian refugee 27 years of age married 1 para, with a right upper lobe tuberculosis and a pleurisy with effusion. The same procedure was carried out on this third patient and 20 hours later she had a spontaneous expulsion of the products of conception. This third case 8 months later died at the Municipal Tuberculosis Sanitarium of a generalized pulmonary tuberculosis.

I report these three cases because I think they give one a new modus operandi in cases in which therapeutic abortion is frankly indicated. Remember, these cases were charity cases and did not want to go to the hospital and especially did not want to go to the Cook County Hospital. All three were followed for months afterward and there were no complications in any one of the three. I hesitate to report the method because of the danger of such procedure being abused but I do feel it is a safe procedure when there are proper indications and there surely were indications in this particular group.

## CÆSAREAN SECTION

INDICATION AND LIMITATIONS<sup>1</sup>

BY GEORGE CLARK MOSHER, M. D. FACCS KANSAS CITY, MISSOURI

THE primitive indication for abdominal delivery was doubtless the attempt to spare the unborn child of a dying mother. This was a practice among the Egyptians and the Jews perhaps even with earlier nations, more primitive people.

Cæsarean section was certainly known to the Romans as witness the *lex regia* of Numa Pompilius one of the early Cæsars, that the body of no woman dying in labor should be buried without the child being first extracted. The interest of the mother of course, was not considered as she was already moribund. The *lex regia* became the *lex cæsarea* or law of the Emperor, under the Cæsars, coming down through the Germans as the *Kaiserschnitt*, thus it was a Royal decree an edict, not a method of operation.

The derivation of the word is questioned by some authorities as to whether it be from *cadere*, *cadere*, *cæsi*, *cæsum*, or from one of several other roots. If the derivation be accepted as from *cadere* to cut it is clear then cæsarean section is a redundancy being a duplication of two words of similar meaning. The terminology must probably be left in doubt.

Whatever the derivation, the operation will probably continue to be known by its present designation, since time and custom have stamped it with approval.

The history of the cæsarean operation is to be divided into four periods.

First the postmortem law, the *lex regia* up to 1500, second 1500 to 1876, third 1876 to 1888, and the fourth since 1888.

Vague tradition doubtless is more than historical fact the source of many stories of the survival of the mother in early sections. It is questioned if Julius Cæsar was thus born, as witness letters he wrote from his various wars to his mother Julia. Several other historical characters including Æsculapius and Edward VI of England were reputed to have been cæsareans. Perhaps they were.

Shakespeare tells us that Macduff was "from his mother's womb untimely ripped", but Dr Harris thinks that this has reference to a horn rip by a bull not by the knife of the barber or lithotomist.

Medical antiquaries have long studied the interesting case of the wife of Jakob Nufer the sow gelder of Segerhausen Switzerland in 1500. The patient was given up in despair by eleven barbers and seven midwives because they saw no indication for her delivery. We are told she was operated upon by the *schwein spayer* himself as he declared, *non secus alicui porco*, just like he would do for a sow. However, since Mrs Nufer lived to bear four other children, including a pair of twins there is a question as to whether the case was not one of full term abdominal ectopic pregnancy and not a problem of contracted pelvis which was thus happily terminated.

It is a far cry from Nufer to the refinement which today is to be seen in a cæsarean section yet for over 300 years we learn that no improvement in results was obtained in maternal mortality in abdominal delivery. Dr Harris of Philadelphia, wrote that until Dr Lusk's case in 1876 no successful operation so far as the mother was concerned, had been performed in America in half a century. In fact he gathered statistics of 14 cases of gore ripping by bulls and buffaloes, with 10 mothers and 7 babies surviving, as against 84 per cent death rate of mothers at the hands of the surgeons.

The victims of the cæsarean all died from hæmorrhage and sepsis, as the uterine wound was not sutured.

Tarnier said that no woman who was delivered by a cæsarean in Paris, 1787 to 1876, survived. Winckel and Stein made the same assertion as to the operation in Vienna.

The indication for cæsarean section in the interest of the mother dates from the third period, that of Porro's supravaginal amputa-

<sup>1</sup>Presented before the Detroit Obstetrical Society October 12 1926

tion of the uterus in 1876 the brilliant results of which would seem to justify the performing of the operation as a means of saving the life of the woman the mortality having been previously 56 to 84 per cent Hence Porro is to be hailed as the discoverer of a humane and comparatively safe operation, which has been a boon to humanity

It is an interesting commentary on the third era that Dr Renkel a medical missionary in Uganda Africa described a cesarean section which he saw done by a native in 1879 The patient was made drunk on banana wine as an anesthetic The operator washed his hands in the same fluid as an antiseptic The incision was made the fetus lifted out the cord was cut the placenta removed and the uterine cavity washed out with the wine The abdomen was held together by two native assistants while the abdominal wound was closed with a figure of eight of grass on pins The entire abdomen was then covered with a paste of herbs The temperature did not rise over 100 The wound was healed in 11 days

The fourth epoch in cesarean begins with Saenger in 1888 This was the first conservative as compared with Porro's section and amputation of the uterus which was of course radical

Porro's method was then relegated properly to the class of cases distinctly infected Saenger's operation preserving the maternal capacity of the woman The present day fourth era includes the conservative section of Saenger the Porro amputation the two flap low cervical incision of De Lee and Beck following that of Frank of Cologne in 1907 (extraperitoneal operation for cases infected) and the vaginal cesarean to which Reuben Peterson in 1914 gave a most enthusiastic discussion even urging it as the operative technique for the general practitioner

Analysis of all the various methods of operation brings the appreciation that each had its virtues in some especial instance for the great majority of cases the indication will still be the classical conservative operation

When a previous attempt has been made to deliver by the pelvic route the membranes being ruptured, when forceps version or

craniotomy have been attempted or even when repeated vaginal examinations have contaminated the field and infection is to be anticipated the Saenger conservative operation is not indicated because of the enormous mortality The choice under these circumstances is to be dependent on the obstetrical judgment of the attendant

The outstanding fact to be borne in mind in estimating the true value of cesarean section is that the perfection of operative technique is not the *sine qua non* in the reduction of mortality Technique has thus marked benefit only in properly selected cases

Not only among the laity but of enormously greater gravity there exists in the minds of the profession today the idea that cesarean section is an absolutely safe and simple operation which can always be depended upon to give perfectly satisfactory results to mother and child

It must be borne in mind that any laparotomy carries its element of the risk even in the hands of the most skilled operator and under the most ideal condition of the patient and her environment Hence a cesarean operation instead of being chosen as one of election after deliberate consideration as the safest and best means of delivery, is adopted by many poorly trained obstetricians and general surgeons who do not pretend to have a working knowledge of the fundamental principles of the art of obstetrics It is looked upon as an universal panacea for all obstetric ills regardless of the condition of the patient her measurements her general health or the history of her case or as one of my confreres in our hospital is fond of saying 'Since a cesarean section is an operation so easy to perform it is like shooting fish in shallow water It is the easiest obstetrical maneuver unless one admits the application of low forceps at the outlet, yet the operation carries with it because of failure properly and intelligently to interpret indications a greater morbidity and mortality than any other abdominal operation done for any pelvic condition

Because of the furore for surgical delivery of the child cesarean section has become such a popular operation that we are prone

to forget that the operation is not to be undertaken simply as an example of spectacular brilliant abdominal surgery. It is rather to be approached in a very different spirit, for it is a demonstration of the obstetrical conscience with limitations which yearly become more hard and fast when measured by the risk rate involved on the part of the mother.

It is an established fact that the scope of any surgical procedure widens as the technique is perfected and as the morbidity and mortality are thereby reduced. Cæsarean section has been no exception to this rule.

It is the endeavor of this discussion to show that while the indication has been properly extended and while statistics can be adduced to prove a mortality of 2 per cent, these figures are based on select cases with ideal environment and experienced obstetrical skill in the management of the delivery, on the other hand, in general the records are appalling because surgeons are being urged, by general practitioners, to do section where no indication is manifested, and in cases in which hours before the stage has passed in which the mother could be safely delivered in this manner.

Dr Rudolph Holmes, of Chicago, gave me in a letter dated April 8, 1926, some most interesting figures bearing on the incidence of cæsarean section. These were gleaned by Dr Tottenham, a young Irish obstetrician, who in 1925, on his way to assume the chair of professor of obstetrics and gynecology, in the University of Hongkong, China, spent a number of months among American maternity hospitals. The information is, of course, first hand, as it was given by officials of the hospitals, to Dr Tottenham personally.

The following figures were obtained. In the Jefferson Hospital Philadelphia, 362 deliveries were done in 1924, 55 by cæsarean section, an incidence of 1 to 6. In the Boston Lying In, there were 1,123 births, with cæsarean section in 92, an incidence of 1 to 12. In the Bellevue Hospital, New York, in 4,286 births there were 44 cæsarean sections, an incidence 1 to 97. In the New York Lying In, 3,511 labors with 5 cæsareans, an incidence 1 to 585. In the Johns Hopkins Hos-

pital there were 875 births for the year, with cæsarean section incidence 1 to 125, since the opening of the hospital the incidence has been 1 to 103. In the Swedish Hospital Minneapolis, in 1,667 births there were 4 cæsarean sections, an incidence 1 to 201. In the Burnside Hospital Toronto, within 8 years there were 6,982 births with 8 cæsarean sections, an incidence of 1 to 861.

The interesting fact of these figures is again the obstetrical conscience. The selection of cases for cæsarean section showing an incidence all the way from 1 to 6 in Jefferson 1 to 12 in Boston Lying-In, to 1 in 631 in Minneapolis General and 1 in 861 in Toronto is a remarkable contrast.

Surely the material reaching the maternity hospital in the various sections of the country can hardly show such wide discrepancy in its anatomical or pathological indications. We must recognize that the personal equation is largely responsible for the statistics.

In a study of 2,000 cases of contracted pelvis in the Montreal Maternity, 1906 to 1924, out of 15,000 labors it was found that 622 cases were of the generally contracted type, 509 were rachitic, 398 were masculine and 18 were disordered. The interesting feature of the analysis is that 75.5 per cent delivered themselves spontaneously leaving but 24.5 per cent which must be relieved by some operative procedure. Forceps deliveries were done in 186 with 2 deaths, 1 from cardiac disease, 1 from sepsis. The infant death rate was 16.6 per cent. Version and extraction was done in 68 cases with one death from hemorrhage and with 30.8 per cent infant mortality. Cæsarean section was done 117 times for contracted pelvis, with a maternal mortality of 5, 3 from sepsis, 1 from cardiac disease, and 1 from sarcoma. Seven of the babies were lost. Craniotomy was done 31 times, always by selection, with no maternal deaths.

In 70 cases labor was induced with no maternal death. These results are fairly indicative of a well organized prenatal service and the cases of pelvic dystocia which must come into the class of operative treatment are differentiated long before the case reaches the stage of an emergency, again proving the



immense value to women in labor of having had prenatal care during pregnancy.

Eardley Holland of Birmingham, in an exhaustive study recently gave the most complete analysis of the risk rate in cesarean section since that of Peterson in 1914. Holland's survey included all the reported cases of cesarean section done in Great Britain and Ireland 1911 to 1930 and his analysis of the indications has become a classic. Included are 4197 cases of section and they are classified according to the indication: contracted pelvis 3372, eclampsia and other toxæmia 27, antepartum hemorrhage 208, other conditions 336.

The mortality in contracted pelvis was 41 per cent. The 1202 cases operated upon before the onset of labor gave a mortality of 16 per cent; in 389 sections done early in labor the mortality was 18. Operation late in labor showed an increase in a death rate of 10 per cent. In 35 cases a previous attempt at induction before the section was done had failed. The mortality here was 14 per cent. After unsuccessful attempt at forceps delivery, the cesarean mortality was 25.7 per cent for the mother and 38 per cent for the fetus; 50 per cent maternal mortality followed unsuccessful attempt at craniotomy.

In the 19 cases of contracted pelvis which resulted fatally, the cause of death was peritonitis 49, sepsis 16, septicæmia 10, pulmonary embolism 8, pneumonia (all types) 17, ileus 2 and intestinal obstruction 3. Of the children 12 were born dead and 151 died in the first 2 weeks. The infant deaths were directly proportional to the duration of the labor. The maternal mortality in 195 cases of eclampsia treated by cesarean section was 5 per cent. The death rate was three times higher after the sixth convulsion. Toxæmia was blamed for 20 cases, pneumonia (all types) 8 and embolism 1. Fetal and infant mortality was 50 per cent. Prematurity was assigned as the chief cause of infant death.

For placenta prævia section was done 139 times with a mortality of 11.5 and a fetal death rate of 27 per cent.

For accidental hemorrhage Holland reports a mortality of 27 per cent in 66 cases.

uterine disease was given as a cause in 20 cases with a maternal mortality of 46 per cent and fetal mortality 86 per cent.

In hemorrhage and shock, the operation was done not primarily to save the child but as the quickest and easiest means of controlling the hemorrhage from the fatigued uterus.

Obstruction by fibroids was the indication in 88 cases and ovarian cysts in 12, carcinoma of the cervix was the indication 25 times. The mortality in fibroids was 10 per cent and fetal death 25 per cent.

Thirty three cases were operated upon because of malpresentation or over size of the fetus.

Grave maternal disease included 40 cases with heart trouble and the mortality in these was 25 per cent with fetal deaths 16 per cent.

Two sections were done for pulmonary tuberculosis and two for habitual death of the fetus during labor.

Holland does not mention the number of cases of secondary sections done, the indication being a previous abdominal delivery. This report covers only the experience of British obstetric surgery. In a discussion of the subject of operative obstetrics in America Polak recently said: "It has been carried to such an extent that even the physiological process of normal labor is being disturbed; a normal child in normal position being propelled by normal mechanism of labor through a pelvis which is ample and with soft parts that are thoroughly dilatable is today often disturbed either by cesarean by version or routine application of forceps as soon as the head reaches the ischial spines. Other operators have so widened the indications for cesarean section that this method is being employed for no real obstetric reason, simply because it is the quickest most convenient way of getting the baby out of the uterus."

The average hospital, however, will show a death rate record of 10 per cent and over while in selected cases under ideal conditions of technique the mortality is less than 2 per cent. This variation between 2 per cent and 10 cannot be all due to difference in

operative ability nor to any other causes than careless and reckless neglect of obstetric principles."

However, Polak has demonstrated that the cesarean patient has imposed on her, even in a clean case, because of the presence of infective bacteria in the cavity of the uterus a possible infection. These bacteria find their way through the open cervix to the wounded area of the uterus, consequently a morbidity follows which the patient operated upon for a tumor such as a fibroid or ovarian cysts is spared.

These bacteria were found by Polak, later by Lossner, on the fifth and sixth day after operation. The sutured wound is invaded as well as the vast culture field which the placental site affords.

In Massachusetts in 1921, cesarean section had displaced eclampsia as the second most frequent cause of death among parturient women. Surgeons in Massachusetts are surely an average in ability so it is again apparent that perfection in operative skill is not alone the important factor in reduction of mortality.

Newell reported a survey of hospitals within a radius of 40 miles of Boston, revealing 100 cesarean sections with 100 per cent mortality, in the majority of these tragedies the fact that cesarean section had been done did not appear in the report.

In a letter from Dr. William H. Davis, chief statistician for *Vital Statistics of the Census Bureau*, dated April 5, 1926, are the following figures showing that the deaths from cesarean are increasing in this country year by year. In 1921, 247 deaths were reported in the United States, in 1922, 266, in 1923, 285, and in 1924, 304. While these are doubtless far from correct since many deaths will be reported as from septicæmia, hæmorrhage or other coincident causes, the figures are suggestive as demonstrating the increased recorded mortality of 22 per cent in 4 years!

In the *American Journal of Obstetrics and Diseases of Women and Children*, April 1908, Dr. Halpenny, of Winnipeg, discusses the indications for cesarean section, and in his conclusions submits a question which he pro-

pounded to a number of operators throughout the country, as to sterilization following a cesarean in a primipara aged 30, with a conjugata of 6.75 centimeters. The answers he received were so varied that one is struck with their lack of harmony, until analysis of the group reveals that it is the state of mind, surgical or obstetrical, which is responsible, for the difference.

Among those consulted were J. Fairbairn Binnie of Kansas City, William J. Mayo, of Rochester, John B. Murphy, of Chicago, George W. Crile, of Cleveland, John B. Deaver of Philadelphia, all general surgeons. The obstetricians consulted were J. Whitridge Williams of Johns Hopkins, Joseph B. DeLee of Northwestern, J. Clarence Webster, of Rush Medical College, Henry D. Fry, of Georgetown University, and William H. Gardner, Montreal University. The verdict was nearly a 50 per cent hung jury. Webster joining the general surgeons for sterilizing, and Mayo and Deaver agreeing with the obstetricians that the woman should have the opportunity of an attempt to have another child. The views of all operators on such points which are fundamental, need to be crystallized before we can expect to bring ideal results into our statistics.

When one goes back to the first principles of obstetrics he must realize the vast transformation which has taken place and how much the operation of cesarean section has been popularized throughout the civilized world in the last 10 years. Where section is advantageously employed we all claim results are admirable, but in cases in which it is contra-indicated, it is not only unjustified, but it becomes a factor in heightened morbidity and mortality.

How are we in America to get back to normalcy in this situation? If you will bear with me a few minutes, let us briefly consider a much neglected phase of prenatal care, and that is the simpler measurements of the pelvis. A suspicion of pelvic deformity is aroused by small stature, unusual gait, malformation of spine, or limbs, or in a primipara, by a pendulous abdomen.

However, pelvic malformation may exist unsuspected, with no outward indication

On the other hand statistics will prove that in the great majority of cases of pelvic discrepancy say 75 per cent the patient will be able to deliver herself without interference. So one may say that the whole problem of cesarean section may be included in two phases of maternal welfare which is after all the very foundation of modern obstetrics first the obstetric conscience which one must have to differentiate the normal voluntary case from the one which requires a section either in the interest of the mother or of that of the prospective child and a second a knowledge of pelvimetry conscientiously applied.

Familiarity with the diameters of the brim and the outlet are essential and are so very simple yet how often are they understood in general practice or how often are they utilized in the every day experience of ordinary management of obstetrics?

I am now pleading with you not only as specialists but as leaders and teachers of the great body of the profession and I ask what percentage of our patients come into the labor room who have had a definite chart made which shows the capacity of the passages and the bulk of the passenger? Perhaps not one in a thousand physicians gives any thought to the matter.

The great multitude of women especially in the South still dependent on midwives which number is I believe estimated at a quarter of a million out of two and one half million confinements annually in the United States are not included in a discussion of cesarean section. Their problems of mortality are in another class. I refer only to those patients who are attended by physicians.

Sooner or later education of the laity will demand that the accoucheur must become familiar with prenatal care just as women have been taught the safety of the hospital. Every doctor should carry a pelvimeter and a tape just as he has a thermometer a hypodermic syringe a stethoscope and a blood pressure apparatus. Every woman putting her life in the hands of a doctor in her pregnancy is entitled to have a careful physical examination, routine advice throughout and close observation measurements, weight etc.

If the external measurements are average normal figures, it may not be necessary to go further in the pelvic investigation than the crests, the spines and the Baudelocque or external conjugate. These should be taken and recorded. If these be found equally diminished a generally contracted pelvis is suspected. If the outlet is diminished it may be a funnel pelvis. The pelvimeter is simply a pair of carpenter's calipers extended and gauged. Any model is good the most popular comprising that of Baudelocque the original French pattern the Martin, the Collyer the Carstens and the Breisky. The last has an ingenious device a small scale for the outlet in addition to the scale for the estimation of the brim and the anteroposterior diameter two instruments in one.

The myriad internal pelvimeters are of no practical use. That of Skutch or Stein is most frequently seen.

The manual examination is far more satisfactory in obtaining internal diameters.

The true conjugate is to be estimated only from the measurement on the index and middle fingers of the right hand passed into the vagina until the middle finger impinges on the promontory and the forefinger is pressed against the subpubic ligament, the forefinger of the left then marks off the lower margin of the subpubic ligament on the right. Both hands are then withdrawn with the left forefinger still at the point marked on the right index the distance is taken by calipers or tape. It is needless to say this should be done carefully, not mistaking a false promontory and not failing to mark off the lower margin of the subpubic ligament exactly.

A discrepancy may be found here as there is some variation in pelvis as to the thickness of the pubic symphysis. Postmortem examinations have shown an error as great as centimeters.

In estimating the true conjugate from the oblique one must consider (1) the depth of the symphysis (2) the height of the promontory and (3) the angle of the symphysis to the horizon.

An old method of manual estimation of the depth of the pelvis described by Johnston

of Edinburgh, was done by passing the whole hand into the vagina, a procedure not to be commended in a refined twentieth century practice. This maneuver might give a skilled obstetrician some idea of the pelvic formation, but in a primipara, without an anesthetic, it would be inconceivable.

It is obvious that all measurements are only approximate. The accuracy of any plan of examination can only be approximate to within 0.6 centimeters. This for all practical purposes is sufficient in the general run of cases.

Another element to be considered in pelvimetry is the passenger. To determine the question of method of delivery, one must estimate the size of the head of the fetus, the head of course, being the usual obstacle if dystocia be encountered from the direction of the child. A student of eugenics will at once visualize the fetus when he sees the two parents. He will form some idea of the size and shape of the head of the baby estimated from the father and mother—only a vague surmise but a suggestion.

A number of expedients have been proposed to measure the head *in utero*, but they have not been found successful. One cannot calculate the degree of ossification, nor the more important element, the consistency of the cranium and its compressibility which are dependent on sutures and fontanelles.

So we deal with some degree of uncertainty regarding both the birth canal and the oncoming head. This led Barbour to say that the fetal head is itself the best pelvimeter, because either head or pelvis may be abnormal in a given case. There must be distinct adaptation to insure voluntary delivery.

In measuring the head Kerr's manual method is far more satisfactory than Perret's cephalometer. Kerr passes the left hand into the vagina. With the right hand he grasps the head suprapubic and presses it into the superior strait. The manner of engagement at the brim can be estimated, also the consistency of the head, and by pressing the thumb along the brim, the degree of overlapping can be found.

By this simple maneuver one may quickly determine the indication for (1) voluntary

delivery, (2) forceps, or (3) cesarean section.

It is needless to say all this examination should be done and information obtained at least a month before delivery. No vaginal examination should be permitted within the limit of a week, regardless of what aseptic precautions have been observed.

One establishes a general rule that cesarean section is always the choice for a live child and craniotomy for a dead one if these come into competition. The exception is met when a case of extreme pelvic deformity (less than 6 centimeters of a true conjugate) is encountered. In this case the body of the fetus cannot be dragged through the pelvic outlet regardless of skill or experience. It is an anatomical and physical *impasse*.

In establishing an absolute indication for cesarean, it would include deformity of 6 centimeters true conjugate and solid tumors in the pelvis, which form an absolute barrier to progress.

The relative indications recognized include (1) pelvis with true conjugate between 7.5 and 9 centimeters, (2) tumors, fibromata or ovarian cysts, (3) placenta previa, (4) eclampsia, (5) ventral fixation, (6) prolapse of cord, (7) impacted shoulder (fetal mortality is 50 per cent even after the section), (8) abnormal condition of the fetus, (9) retraction and contraction rings, (10) scar tissue causing rigid cervix, (11) serious condition of the mother, such as cardiac disease and advanced pulmonary tuberculosis, extreme oedema of the vulva.

When an indication exists postmortem cesarean section should always be done in case of a dying mother.

To analyze the indications one may say that with a Baudelocque of 17.5 centimeters, a fetus may usually be delivered by the normal passage provided there is no fetal overgrowth. If the oblique conjugate is 10.5 centimeters the true conjugate should be estimated as being 8.5 or 9 centimeters.

We have for a number of years taken McDonald's and Ahlfeld's external measurements for estimating the fetus *in utero*, and with us it has been of much approximate value in determining the size and weight of the child. If the McDonald dimension is checked

by that of Ahlfeld and an endeavor to measure the accommodation of the head to the inlet by Perrett or Barbour's maneuver is made one is fairly safe in predicting a voluntary or at the farthest a forceps extraction.

On the other hand if the head does not approximate the capacity of the inlet and we find the true conjugate less than 7.5 and on the other hand the McDonald is over 37 centimeters or the Ahlfeld over 28 centimeters one should consider the advisability of a section at the onset of labor. Above 9.5 centimeters of a conjugata vera no trouble need be anticipated from contracted pelvis.

The funnel pelvis which has a bischial diameter of less than 7 centimeters is usually a barrier to normal delivery at the outlet, even if the inlet be capacious.

Cæsarean section is indicated in the presence of tumors if they are a definite interference. Dickinson gathered statistics from which he estimated that in New York State alone there are 350,000 women with fibroids. The majority of these women are not aware of their condition. If they become pregnant they deliver themselves voluntarily.

There must be a positive dystocia to justify an operative delivery in case of fibroids, a fact which I attempted to prove in a paper read at the meeting of the American Association of Obstetricians Gynecologists, and Abdominal Surgeons at Hot Springs, Virginia. If the myoma be located in the fundus it is not an indication for interference. An incarcerated ovarian cyst with a twisted pedicle demands operative delivery of the child.

In regard to placenta previa as an indication for cæsarean section a letter from Dr. J. Whitridge Williams dated April 14, 1926, gives his views with which my own experience coincides, that is that it is the rare case in which cæsarean section is indicated for placenta previa one with a rigid cervix undilated and a complete central previa.

In general in my hands the Voorhees bag has served most admirably to plug the cervix and to press against a marginal previa until a sufficient dilatation is obtained to do a version and extraction. Williams gives a history of 40 cases treated at Johns Hopkins Hospital

with bag induction with only one death. Whitehouse in the *Journal of Obstetrics and Gynecology of the British Empire*, also follows the same technique. His experience in the Birmingham Hospital included 211 cases treated by version which resulted in a maternal mortality of 4.2 per cent and a fetal mortality of 91 per cent. Thirty-five cases by the bag method had no maternal death, a fetal mortality of 75 per cent. The cæsarean section he claims is indicated only when symptom arise after the eighth month and it is assumed the initial hemorrhage has not impaired the child's vitality.

Kerr considers that cæsarean section is indicated for central placenta previa. His figures being 10 per cent maternal and 13 per cent fetal mortality, while the older methods showed 4 per cent maternal and 40 per cent fetal mortality.

As an indication in eclampsia it was the consensus of opinion at the British Congress of Obstetrics and Gynecology in 1922 that only a case with no labor, a long hard cervix, no progress in 6 hours of conservative treatment should be sectioned.

Considerable doubt has arisen in the last few years as to the curative effect of rapid delivery in eclampsia as contrasted with conservative methods.

It is in eclampsia indeed that cæsarean section suffers its most glaring abuse. The consensus of opinion among competent obstetricians is that the mortality, averaging over 30 per cent, is too high a penalty to pay in the face of results by purely obstetrical measures which have never been approached by those of abdominal section.

The only instance in which the toxæmic patient should be subjected to the added risk of a section is the case of the primipara with unyielding cervix who has a preclampsic history, whose condition suddenly becomes grave, and whose symptoms are not relieved by venesection, veratrum nor morphine after 6 hours.

In Reuben Peterson's conclusion as to the treatment of eclampsia by cæsarean section he divides the cases into two groups to be analyzed for study: first those undertaken before 1908, when the technique test of 12 hours

labor resulted in 11.2 per cent mortality because of delay, and second those since 1908 in which operation by election has reduced the mortality to a percentage of 6.1

In his contrast of results of treatment by radical measures, Williams reports a mortality of 24 per cent in radical operative procedure in eclampsia, as against 13 per cent in the Stroganoff series and 10.5 per cent by the Dublin method

Ventral fixation is today not so popular a gynecological method as it was a few years ago, so it is not so likely to be presented as an indication for cesarean section, though two cases were seen last year in which dystocia was due to this cause. Williams says that the anterior wall of the uterus buckled in one of his cases in which the junction was effected, the head in one compartment, the feet in the other, thus necessitating a cesarean section

There is ordinarily no indication in my opinion for cesarean section in prolapsed cord, impacted shoulder posterior position, nor impacted breech unless in a very exceptional condition. Persistent Bandl ring retraction is a legitimate indication

Too little discussion is apparent in reference to the dictum "once a cesarean always a cesarean"

While in 1924, I fortunately was able to deliver 3 patients by orthodox method, *per via naturalis*, subsequent to a primary section, the exhibit of Dr. Hillis at the Cook County Hospital, Chicago, of four ruptured uteri occurring in the service between March and September, convinces one that any case may be one of the 4 per cent, which is the universally accepted figure as to frequency of rupture of the uterine scar in a subsequent pregnancy

Many of these ruptures have occurred previous to labor, thus emphasizing the necessity of elaborate attention to the technique of suturing the uterus following the operation of section, and especially of accurate information as to infection following the cesarean section

One cannot rest from a discussion of this sort without calling attention again to the reports of Polak, in Brooklyn, in which he contrasted the mortality of the cases operated

upon by election, followed by a maternal mortality of 2 per cent, and those brought in from outside the hospital, potentially infected with a mortality of 6 per cent, and those frankly infected before admission, in which the mortality was 11 per cent

No apology is made for this discussion of this subject since the abuses which have crept into its performance have become such a glaring matter for criticism. The whole question is again one of education. If we can convince ourselves of the proper indications for cesarean section that they are definite and that the violation of the recognized limitation will surely be punished, we shall become better obstetricians and the patients will be saved the risk which it is needless to attempt to emphasize and which they are forced to take, with results which outrage the obstetrical conscience as well as the principles of good surgery

The absolute contra-indication for cesarean section is a case in which the child is dead or seriously threatened with danger of dying. If the mother is infected or in an environment which renders an aseptic operation impracticable, craniotomy should be the operation of choice. However repugnant the destruction of the child may be it is a matter of expediency to be met, but the woman alive and perhaps already a mother, is of more value to the family and to the state than the unborn fetus which has all the vicissitudes of infancy and childhood to encounter. This is not the teaching of the church but in fact it is the position one must assume who realizes the gravity of his responsibility at a time when prompt and clear thinking are of such paramount importance in reaching a conclusion

Of course no such decision can be acted upon without consultation and a careful explanation to the family of the risk involved. If it is deemed, after free discussion, that the child is to be spared, regardless of risk, the uterus should be removed at once, after the delivery. Several Kansas City general surgeons have for years had a rule that they will not operate on a case brought in for a cesarean section without having consultation with an obstetrician

This gives an experienced opinion as to the general problem "Is there a physical indication for interference?" Also in the light of our knowledge of results in late caesareans after hours in labor repeated vaginal examinations ruptured membranes attempts at forceps versions and other procedures it is apparent that the woman is almost certainly condemned to death if a caesarean section is done under any of these untoward circumstances. We spare her this risk even if the alternative must be a craniotomy.

A case illustrating the trend of the modern surgical mind occurred recently when a very competent general surgeon asked that I be called after two general practitioners had the patient draped and ready for him to perform a caesarean section on account of the failure to deliver a large child in posterior position. No pelvimetry had been done and the woman had been 24 hours in labor and the membranes were ruptured before she entered the hospital.

I took the external diameters which seemed ample found the dilatation complete was able to do an easy version and fortunately both mother and child made an untroubled recovery. I assured them it was only good obstetrics.

This case is only mentioned to show that morbidity and mortality in these cases are dependent on obstetrical judgment far more than on the operative skill of the surgeon of recognized skill and ability. We must admit that an operation which carries an average death rate of 10 per cent has something wrong which demands investigation.

Unfortunately these cases are not segregated but are scattered throughout the country and do not excite the apprehension which would follow were the patients under the care of one operator or a group of surgeons.

A very good suggestion comes from Dr. deNormandie, of Boston who says that in the operating rooms of one of the hospitals in Massachusetts there were posted notices that no section should be done without consultation. This followed 3 deaths which occurred in succession under care of one operator.

Publicity is a wholesome sedative to the enthusiasm for operation which will not harm

any clinic and may be one source of benefit in reducing our mortality in caesarean section. Dr. deNormandie remarks that no man likes to have aired his bad results before a group of confreres.

In regard to the question of indication from the standpoint of the patient's relative safety in the choice of procedure it must be emphasized that it is only when a caesarean operation is an elective one done at an appointed hour just before or just after the onset of labor for a definite obstetrical indication that results under these circumstances are beyond reproach. However when as it is too often the case it is an emergency section which is done in neglected labor by an occasional operator the mortality promptly climbs to appalling heights.

#### CONCLUSIONS

The indications for caesarean section may be thus condensed:

1. A Baudelocque of less than 1, centimeters and a true conjugate of 6 centimeter or a tumor blocking the outlet is a positive indication.

2. Seventy five per cent of all pelvic contractions allow delivery by natural passages.

3. The classical conservative or Saenger operation done when indicated by election is comparatively safe. The mortality should not exceed . per cent for the mother.

4. Maternal mortality is increased by leaps and bounds through rupture of the membranes attempt at forceps induction version craniotomy or even frequent examinations *per vaginam* previous to the section. After any of these have occurred craniotomy should be selected in the interest of the mother's life.

If a section is done after potential infection it must be a Porro or a low extraperitoneal operation.

5. In eclampsia the indication for caesarean section is limited to the cases of a primipara with rigid long unyielding cervix no improvement following 6 hours of conservative treatment.

6. Placenta previa is most generally an indication for Voorhees bag induction the exception being severe bleeding with no dilatation in a *previa centralis*.

7 Fetal mortality is to be reckoned according to whether the section be demanded by pelvic dystocia or by maternal disease. In the former a minimum death rate for the infant may be predicted. In the latter the risk to the child due to hæmorrhage toxa-

emia, or prematurity is necessarily vastly augmented.

Finally, the indication for cesarean section when we have reached utopia will be entirely dependent on prenatal care and the obstetrical conscience.

## FUNDAMENTAL TRAINING FOR OBSTETRICAL NURSES<sup>1</sup>

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**D**URING recent years much has been spoken and written on the nursing situation and the impression has grown that a lack of co-operation and co-ordination exists between organized nurses and the medical profession. In addition the quasi political nursing bureaus of various states have, by rapid stages, developed an autocratic control over hospital training schools which has in many instances curtailed their efficiency and engendered a feeling of resentment and antagonism among physicians. This feeling has found expression among organized medical bodies in various ways, from the adoption of protesting resolutions to the formation of committees to study the subject and propose remedies. It is not within my province to enter into a lengthy discussion and argument over these various phases of the changing nursing problem, but merely to refer to them in passing, while considering the particular interest of our Society in the education of obstetrical nurses.

The conception of nursing held up to the time of Florence Nightingale and, indeed, until the beginning of this century, has been superseded after a comparatively rapid development by another view, which has placed this former assistant of the doctor in practically a separate and distinct category. As the opportunities for the practice of the nursing profession increased, so the desire for independence likewise became a prominent feature in this development. Legislative enactments in various states have created a class of "registered nurses," in a fashion similar to that which obtains for physicians,

and the public's conception of a "trained nurse" is no longer the legal one.

In former years, hospitals undoubtedly exploited their nursing staffs for their own benefit and it is quite natural that a resentment against such abuses should develop. Nurses have banded themselves together into organizations for their own well being and have, in addition, aided in the development of a system of nurse training which should be of equal benefit to the practitioners of this profession, and to medical men and their patients. Unfortunately, however, the trend has been away from medical supervision strictly speaking, in the conduct and organization of nurse training schools and has become largely a matter of lay direction. Moreover, during the last 25 years the education of nurses has drifted strongly toward the acquiring of medical knowledge rather than nursing technique. Undoubtedly, an intelligent nurse should have a knowledge of elementary medicine, or medical facts, in order properly to appreciate nursing procedures. A survey of the curricula, however, leads to the observation that more medicine and less nursing has resulted from the effort. Just how much the medical profession itself is to blame for the unrestrained expansion of higher nurse training is a question not to be settled off hand. Medicine of today, in certain of its phases, requires a personnel which should be trained in accord with these demands. In other words, we need women to fill newly created positions in social welfare work, in schools, in maternity and child welfare centers, and in a number of other fields.

<sup>1</sup>Read at the fifty second annual meeting of the American Gynecological Society, Hot Springs, Virginia, May 24, 1927.



It would appear, however, as if the ambition to occupy these higher planes had resulted in a greatly diminished desire to care for sick people in ordinary illnesses.

The diversions of opinion which have developed during recent years as to what should and what should not comprise nurse training has led to bitter quarrels and recriminations which have buried the true facts in the question. We hear much about over trained nurses just as we hear about over trained doctors. We are constantly importuned for greater nurse training facilities. The dictation of our quasi political nurses organizations is gradually becoming a nuisance and in some cases a scandal. The question remains what shall be done to adjust this situation? How shall we bring the doctor and the nurse to a realization of the proper limits of this important activity? And how shall both sides be accorded satisfactory participation so that the great public which in the end pays the bill shall not be neglected?

There are several features economic and otherwise connected with the development of nursing as we find it today which must be taken into consideration in discussing the so called nurse problem. It would require more time than can be allotted to this discussion to take up all of these. It is my purpose not to include any of the extraneous aspects of the question but to limit my remarks to the curriculum or course of study in the belief that an association of specialists such as this is at least in a position to propose what shall be included in a nurse's training with particular reference to the field covered by its activities namely obstetrics and gynecology. Of these two obstetrics stands by itself for most of the elements of gynecological nursing are similar to those of general surgical nursing.

In practically all of the states of the Union, centralized bureaus for the direction of nurse training have been established. Their individual requirements for training are based largely on a standardized curriculum developed by a Committee on Education of the National League of Nursing Education. The first edition of this curriculum was published in 1919 and the sixth edition has recently appeared. Its main objective is to help in

raising the general standards in teaching and to secure greater uniformity in the curriculum of nursing schools throughout the country. A so called basic course is proposed and a careful division of hours and subjects is presented to include a course of training of either 28 or 36 months. This curriculum has been largely developed by a committee of nurses. One of its most striking features is an almost equal division of hours in medicine and the technique of nursing. It is interesting to note what this committee believes to be the practical objective in nursing education and then compare it with the result. A nurse is stated to 'belong to one of several professional groups within the general field of medicine and shares with them in the effort to care for the sick, to cure disease to prevent suffering and to promote a high standard of health both in individual and in community life.

The nurse's service is claimed to be both a personal and a community service and her duties and responsibilities have been theoretically grouped as they relate to the patient the hospital the physician the household the community the nursing profession and finally herself.

One of the statements which strike the reader as possibly a basis for some of the prevalent discontent is that "the nurse does not exist to aid the physician, but both exist to promote the best welfare of the public". In other words an entire change has taken place in the attitude between the nurse and physician as it was formerly believed to exist and we are no longer privileged to speak of the nurse as the handmaiden or assistant of a doctor. In the words of a prominent nurse educator a nurse exists not primarily to serve the physician but to serve the individual and the community and to protect and conserve life in both sick and well."

In view of the limitations of the nursing field as generally viewed by the medical profession has there not been developed as a result of a lack of interest on our part or possibly for other reasons a calling which is no longer in harmony with the practitioner of medicine? In this connection attention may be called to another statement in the 'Standard Curriculum' given in answer to the contention

of those who are concerned mainly in increasing the supply of bedside nurses, and believe that the basic course should deal with sick nursing only, while all preventive and social aspects of nursing should be considered as belonging to the specialized field of public health nursing and relegated to a period of postgraduate training. It is quite evident, however, that this is not the opinion held by the majority of nurses, or rather by the League of Nursing Education, which, on the contrary, considered public health nursing just as fundamental as bedside nursing and the prevention of disease at least as important a function of the nurse as the care of the sick.

In order to accomplish these ends it is possible that standards have been developed which do not meet the needs of either the medical profession or the public. This may well be compared to a method of teaching medical students, in which the elementary facts of medicine are side tracked and importance given to training in the specialties and laboratory procedures. Perhaps we have erred in this respect in our medical schools and probably this would account for the lack of general practitioners and physicians of the old school, men who were able to diagnose disease without laboratory aid and treat it in its ordinary manifestations. It must be recognized that specialists had better be developed by methods which are applied after the basic training in medicine has been secured. It is the narrow field of specialism which in our own branch has resulted in the contracted viewpoint that is of doubtful value to the profession itself and certainly to the community. Shall we sit idly by and permit an allied field of medical activity which depends, or should depend, entirely on the medical profession, to develop at a tangent where elementals are no longer considered of importance and where the ambition of every graduate is not to be an agent for the care of the sick, but to take up public health nursing, or similar independent activity?

In order to present the present status of nursing education in obstetrics, a careful study was made of the curriculum prepared by the National League of Nursing Education,

the curriculum of the New York State Nursing Department, and a large number of textbooks intended for the instruction of nurses. It is not necessary at this point to take up the general scheme of instruction except to note that during the first term of 15 weeks, 22 hours are to be devoted to class and laboratory work, 16 hours to practical work in the wards, and 22 hours for study. In the second half of the first year the class in laboratory work is reduced to 12, the practical work increased to 36, and the study hours reduced to 12. In the second year the weekly schedule includes 6 hours in lectures and in class, 48 hours in practical work and 6 hours of study. In the third year the schedule of the second year is repeated.

Let us examine somewhat more closely the curriculum of obstetrical nursing. The total time allotted is 30 hours of lectures and demonstrations in a total of 3 months' service. The instruction includes 10 hours of lectures by an obstetrician and 20 hours of classes by instructors. The lectures include the history and scope of obstetrics, with the basic factors in anatomy of the female pelvis and generative organs, embryology, the physiology and hygiene of normal pregnancy, the complications and accidents of pregnancy, the toxemias of pregnancy, normal labor, obstetrical operations and complicated labors, normal puerperium, complications of the puerperium, and the normal baby and its care. These lectures are interspersed with the classroom work and ward demonstrations on the technique of obstetrical nursing.

All of this seems quite simple and *a propos* of what we would expect of a nurse as regards a knowledge of elementary obstetrics and the care of the obstetrical patient. Apparently this allots one third of the nurse's time to obstetrical theory and two thirds to nursing technique in addition to practical ward attendance. But as a matter of fact we frequently find that the examination papers, both in the hospital and in the State Board tests, are based not on the elementary obstetrics that would apply to nursing procedures. Rather, they are of such a character as would make it difficult for the average, recently graduated physician to pass them in applying for a license to practice.

Obstetrical nursing must be regarded as a very important branch of the nursing curriculum. A large number of nurses should be required by the community in this field. For this reason it would appear logical to assign as much as if not more time to this than to any other branch. But we find this is not the case, and psychology for example is given just as many hours in the course as obstetrics. The subject is too extended for comment at this point but a reference to the *Standard Curriculum* on page 131 of the sixth edition will fully explain my point. I have no desire to denude or to ridicule great as the temptation may be. Nor shall I question the value to a nurse of the James Lange theory, the knowledge of the learned and unlearned S. R. Bonds, the ability to apply the law of association, huffing or a proficiency in recording all these things in curves and graphs. But I do ask whether 30 hours of these studies with equal credit at examination time as would be secured from the obstetrical course is a fair and justifiable arrangement? Whether a scientific knowledge of psychology is more essential for a nurse than a medical student may be a matter of opinion. It all amounts to knowing how to think straight or more plainly speaking how to exercise common sense and I question whether the majority of women who take up nurse training can ever be taught the latter in a class room or a laboratory. Contact with patients, contact with hospital practice and routine, competition with her fellow students and drill drill and more drill will develop initiative, skill, kindness, aptitude and the ability to handle her patients more than the required 30 hours of psychology in the class room and poring over text and reference books. And there is likewise another 30-hour period in the basic nurse training course devoted to psychiatric nursing and 30 hours to the ethics and history of nursing and 30 hours to modern social and health nursing—all very interesting perhaps but of what use to a bedside nurse in the care of a sick patient? I believe that the curriculum generally accepted as a standard is unbalanced because it does not bring into the foreground the essentials of what a nurse ought to know, on the contrary it clouds the important elemen-

tary knowledge by a top heavy superstructure of non essentials which takes away from the nurse the understanding and consciousness of her proper position in the field of medicine.

The defense of the newer aspects of nursing has been set forth in many books and magazine articles and particular attention attaches among others to a collection of essays by Miss M. A. Nutting.<sup>1</sup> Here one is impressed by the high ideals of the author for her profession, ideals that are constantly reiterated, ideals however which seem to incline toward the so-called higher education of nurses and less toward what we as physicians regard as the proper and chief functions of a nurse, namely the care of the sick. This book by Miss Nutting should be widely read by physicians in order to obtain a conception of the tendencies of modern nurse training of which according to the author there are four great branches: teaching, administration, work in training schools and hospitals, public health work and finally private practice. Every other activity except the latter is stressed and the canon call is for better educated women to go into nursing for the sake of the opportunities in public health and social welfare work. These higher ideals of what must still be regarded as a comparatively modern profession are beautifully expressed but one becomes somewhat sceptical of a structure which scarcely serves its original purposes. The impression that one gains from a reading of such books and articles is of a desire for something which is not nursing in the accepted sense, but rather an essay into medicine. And so we find in the teaching curriculum that a great deal of stress is laid on methods of preventing disease, on treatment, on public sanitation, on a variety of similar topics which should be a part of the equipment of a medical student and a physician, likewise many of the reference books noted for supplementary reading are those essentially intended for the training of doctors.

One can have no quarrel with the desire of the leaders of the nursing profession if their ideals tend to the elevation of their associates. It is possible that modern medicine

<sup>1</sup> *A Sound Economic Basis for School of Nursing and Other Address*  
New York: G. P. Putnam & Co. 1916

demand a class of practitioners who are not physicians but can fulfill certain tasks that are the developments of the present day. But, has this not resulted in lowering in the estimation of the pupil nurse, the importance of nursing sick people? Will it not be necessary for us to dignify a basic training course as the high ideal of the nursing profession, rather than to make it a stepping stone for the more advanced branches which now seem to fill the picture? I believe that an organization such as the American Gynecological Society should stamp with its approval a curriculum in obstetrics for example, which will fill the need for trained women in this important branch of nursing and for that purpose a course of training in which the essential is service rather than technical knowledge of a medical character.

In proposing the accompanying syllabus as a part of basic nurse training in obstetrics, due apology must be made for its brevity, as it is merely intended as an outline for a more complete manual of lectures and demonstrations possibly fostered by this Society.

The teaching of obstetrics should be limited to such things as are directly necessary in order to care intelligently for an obstetrical patient. Obstetrics should be taught by a physician who must have in mind the needs of the nurse and not the needs of the medical student. The demonstrations should be conducted by qualified nurse demonstrators, who must arrange their work in accordance with the theoretical lectures in so far as this can be done. In acquainting nurses for example with the anatomy of the female generative tract the fact should be borne in mind that this knowledge should be intimately related to nursing processes. For example the location of the urinary meatus is more important than a knowledge of the histology of this organ, the position of the uterus and adnexa and their participation in the gestational processes is more important than a knowledge of the structure of the endometrium and the graafian follicles, the relation of the rectum to the vagina is more important than a knowledge of the blood supply and innervation of this structure, what to do in a case of prolapsed cord is more essential than a knowledge of the fetal

circulation and the changes which take place at the time of birth. Similar instances might be multiplied. It is essential that a nurse be kept in contact with delivery room practices and thoroughly informed on how to count the fetal heart, how to recognize the various kinds of pains, how to diagnose rupture of the membranes, how to note the symptoms of an impending toxemia, how to recognize the onset of a septic process. Above all, she must be taught not to assume responsibility, particularly in the face of doubtful symptoms, but to transfer this responsibility to the attending physician. The basic training of a nurse should be divided in such a manner that she is not kept at one task for an unreasonable length of time and the proper balancing of her training in this field consequently neglected.

In proposing the following condensed syllabus of theoretical and practical teaching, the set period of 30 hours as a minimum has been adhered to, although neither the lectures nor the demonstrations may take up the full number. This will afford time for review lectures and for quizzes on the practical demonstrations. The textbooks on obstetrical nursing which have been thus far recommended, should either be supplemented by simpler editions or subjected to revision in which the essentials treated in the lectures are noted and stressed. Moreover it is of great importance that medical men lecturing to nurses on obstetrics be thoroughly instructed as to the character and purpose of their lectures, that such lectures be given by the attending staff, preferably the seniors rather than by the resident internes.

With these thoughts in mind the following syllabus of obstetrical lectures is suggested.

- 1 *Anatomy as related to obstetrics* Bony pelvis—general structure, integral part of birth canal, influence of labor. Organs of generation—uterus, ovaries, tubes, vagina, vulva. Relations of vagina, rectum and bladder. Breasts. Elementary physiology.

- 2 *Physiology of reproduction and pregnancy* Menstrual life, puberty to menopause. Embryonic development, impregnated ovum to full term fetus. Fetal membranes, liquor amni, placenta, cord. Relation of mother to fetus, maternal impressions.

3 *Necessity of prenatal care* What does this include? Hygiene of pregnancy, diet, clothing, exercise

4 *Pathology of pregnancy* Nausea and vomiting—degree treatment Interruptions of pregnancy abortion and premature labor, accidental hemorrhage placenta prævia etc. Intercurrent diseases heart lungs kidneys, exanthemata grippe

5 *Toxæmia early and late* Causes varieties treatment

6 *Labor* General features stages pains mechanism presentation progress delivery of baby and placenta Analgesia anesthetics

7 *Puerperal period* Involution of uterus lochia care of breasts subinvolution, pyelitis, phlebitis puerperal mania sepsis

8 *Complications* Prolapsed cord or extremity hemorrhage precipitate labor Operations—forceps version cesarean section induction of labor perineal and cervical repair

9 *Newborn infant* Care feeding intercurrent diseases premature infants

10 *Quiz*

*Practical demonstrations* Each of these should be extended through 2 hours and be followed by quiz

1 Anatomy 2 Hygiene of normal pregnancy 3 Care of abnormal pregnancy 4 Preparations for labor normal 5 Preparations for labor abnormal 6 Puerperal care in normal case 7 Care of puerperium abnormal 8 Complications of pregnancy 9 Care of toxæmia 10 Care of newborn

It is not now possible to present in detail more than the foregoing syllabus of lectures and demonstrations in obstetrics, but it would seem that the American Gynecological Society could well develop through the agency of a committee or otherwise a compendium or manual of obstetrical nurse training working in conjunction with a selected group of nurses for the consideration of the more strictly technical phases of the subject. The lectures in obstetrics should be plainly outlined and I feel that if published this would serve as a basis for the training of nurses in this branch which would bear the stamp of authority and constitute a guide for those medical men and nurse instructors concerned

directly with the teaching of the subject. The many textbooks on obstetrical nursing—and their number is legion—are not, I believe, suitable for the nurse. Ordinarily they fail to stress the facts that are essential in her training. For example in a rather well known manual the general subject of obstetrical operations is suitably presented but is followed by the detailed technique of various obstetrical procedures including the steps of a cesarean operation with its indications and a full account of the manner in which the uterus must be sutured. Why burden the mind of a nurse with information of this character and not have her well grounded in what to do for an acute obstetrical hemorrhage or a fissured nipple?

Much has been said by certain leaders in the nursing profession about the lack of endowment for nurse training and about the hospital work which is done by pupil nurses whose services are supposed to cover the expense of instruction. This is true to a certain extent and no doubt the nurse has been exploited by the hospital. Nevertheless in this connection one may call attention to the fact that at the present time nurse training constitutes a constantly increasing item in the hospital budget, what with directors and assistant directors nurse instructors and head supervisors elaborate housing and recreation facilities and equipment with laboratories—chemical bacteriological etc. And remember that this training is not only for nurses who are to take care of sick people but also for the production of social welfare workers and other classes of nurse practitioners from whom the hospital gets little or no benefit. Also we must not lose sight of the fact that a hospital must serve likewise for the education of physicians whose hours of attendance as members of the house staff are much longer and more irregular than those of the nurses and for whose comfort only essentials are ordinarily provided.

The remarkably rapid growth of a variety of social welfare movements in this country during recent years has called for many nurses as active participants. In the obstetric field in particular the advent of the prenatal clinic and the extensive maternal welfare

agencies developed by the Shepard Towner measure, have called for a large number of nurses to whom are delegated many administrative and often strictly medical functions. For these purposes we require more than our basic course and special facilities should be provided such as the post graduate courses furnished by the Maternity Center of New York and similar organizations.

The countrywide agitation over the nurse problem calls for constructive action on the part of the medical profession. Some progress can be made when organized bodies such as this Society, will actually propose what they deem necessary in nurse training after suitable conference with representatives of the officially recognized nursing organizations. There should be closer co-operation and the guiding hand of the physician should be more manifest in the training of nurses than has been the case in the past. In addition there are many strictly medical duties that should not be relegated to nurses, especially in certain welfare activities. It is not just to the public to do this. It is not fair to the nurses

themselves as they have not been properly trained to carry out many of the functions which are now relegated to them.

We have heard in recent years a great many disagreeable and condemnatory things about the nurse by members of the medical profession but very little of constructive suggestion has been advanced from the same source. In order to assist in a solution of this problem of nurse education and administration, it is essential above all else that a proper balance be developed. This will require closer co-operation and supervision by the medical profession of nurse training. Those who require the services of a nurse must state what the requirements shall be and I propose here with that the obstetricians begin by stating what they think is needed and let other classes of practitioners follow their example. Then we will have made a beginning at least in so far as basic training is concerned and the difficulties of licensing administration etc. can be taken up and studied in turn as part of the general subject with less working at cross purposes than is now the case.

# CLINICAL SURGERY

FROM THE CLEVELAND CLINIC

## TECHNIQUE FOR REMOVING STONES FROM THE UPPER URINARY TRACT

By W. E. IOWE, M.D., F.A.C.S., CLEVELAND, OHIO

**S**TONES should be removed from the ureter, kidney, pelvis and calyces with the least possible damage to the structure involved. When the stones are in the lower end of the ureter, manipulation through a cystoscope will often succeed, but a too prolonged attempt may cause considerable traumatism to the ureter. If the stone cannot be readily removed by means of the cystoscope, a cutting operation should be done. I have found that the operation is greatly facilitated by the use of the flexible curette shown in Figure 1. The value of this curette lies in the fact that it is very flexible and yet stiff enough to resist an ordinary pull and that the cup-shaped lip has its overhang directed toward the shaft of the instrument.

This curette can rather readily be pushed past the stone which is caught in or against the lip as the curette is withdrawn (Fig. 3A). Thus by gentle traction the stone can be rolled out of its position toward the incision in the ureter (Fig. 3B and C). By gentle manipulations the curette can be passed through a rather small opening in the ureter or kidney pelvis; one is not so likely to break off a particle of the stone with the curette as with forceps, and the curette can be used around the corner in the kidney pelvis thereby dislodging a stone in a calyx which would not be accessible to forceps (Fig. 3D and E). With the aid of this instrument I have been able to remove stones from the kidney pelvis and the calyces without lifting the kidney out of its bed, a very important consideration as any unnecessary manipulation of the kidney necessarily must interfere with its proper functioning. Of course



Fig. 1. Front and side views of flexible copper curette.

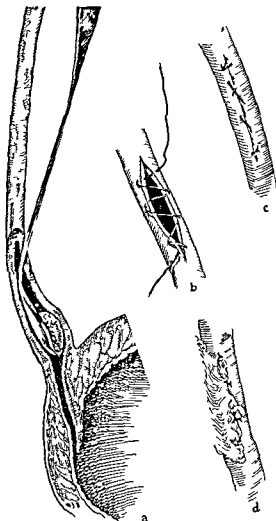


Fig. 3. A. Technique of removing stone from lower ureter near its opening into the bladder. B. Continuous suture through cut edges of ureter; the suture passes between serosa and mucosa. C. Incision after suture is in place. D. Fat tabs from adjacent territory sutured over line of incision.

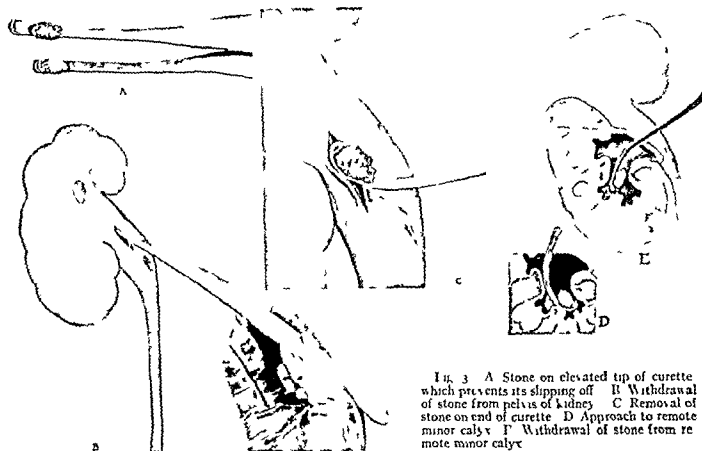


Fig. 3 A Stone on elevated tip of curette which prevents its slipping off B Withdrawal of stone from pelvis of kidney C Removal of stone on end of curette D Approach to remote minor calyx E Withdrawal of stone from remote minor calyx

this instrument is not designed for the removal of a large forked stone such as sometimes fills the entire kidney pelvis and calyces, but rather for the smaller, loose stones

In removing a stone from the ureter it may be desirable not to make the incision in the ureter directly over the stone, as, for instance, when the stone is lodged in the lower ureter, very near its opening into the bladder. In such a case it is well to make an incision above the point at which

the stone is lodged, the curette is then passed through the incision and is carefully guided along the ureter until its lip has passed beyond the stone, which can then be dislodged by gentle manipulation and brought to the opening in the ureter (Fig 2A). The incision is closed by a continuous suture which passes between the serosa and the mucosa of the cut edges (Fig 2B and C) and fat tabs taken from the adjacent territory may be sutured over the line of incision (Fig 2C).



FROM THE CLINIC OF DR. TERRI, UNIVERSITY OF CALIFORNIA MEDICAL SCHOOL

## THE TECHNIQUE OF GASTROJEJUNOSTOMY WITHOUT CLAMPS

By JOHN HOMER WOOLSEY, M.D., F.A.C.S., SAN FRANCISCO, CALIFORNIA

**G**ASTROJEJUNOSTOMY despite the many accusations made against it by those who know and those who do not is still the one procedure that gives universally better results for duodenal pyloric and low gastric (antral) lesions. Pyloroplasty is preferred if possible and partial gastric resection has its indications but gastrojejunostomy is of necessity a more common procedure. The technique of gastrojejunostomy ordinarily embodies the use of compression clamps although evidence is at hand that jejunal ulcers have occurred exactly where the clamp pressure was applied. In our endeavor to eliminate all possible causes for gastrojejunal and jejunal ulcer—one of the greatest objections to gastrojejunostomy—we are seeking atraumatic surgery. The compression clamps were developed originally to prevent leakage and contamination from the gastro-intestinal canal. Today with proper pre-operative preparations and proper operative technique, leakage does not occur. In addition it is recognized that the jejunal duodenal and stomach content except in malignancies is relatively sterile. Therefore since it is less traumatic as well as easier to perform a technique without clamps is employed at this clinic for gastrojejunostomy.

## INDICATIONS

Gastrojejunostomy is indicated (1) where the degree of inflammatory reaction in the region of the pylorus is too severe to allow a pyloroplasty, (2) in the presence of a penetrating duodenal ulcer in the head of the pancreas with or without complications, (3) in the presence of duodenitis, (4) in benign gastric lesions at a distance from the pylorus, (5) in the first stage of a Billroth II resection, (6) when the patient's poor general condition demands a two-stage resection, and (7) as a palliative measure in cases of inoperable gastric malignancy with obstruction.

## PRE-OPERATIVE PREPARATION

Pre-operative preparation is of maximum importance. The routine followed is based upon the combined personal clinical observations and study of our staff. In general, all patients are given a soap-suds enema the evening before and then allowed to sleep as late as possible in the

morning. A light supper is given unless pyloric obstruction is present and water *ad libitum* is allowed up to the time of operation. In instances of pyloric obstruction with 50 per cent stasis gastric lavage is employed 1 hour before operation while in instances of total or subtotal stasis gastric lavage is given twice daily during the last pre-operative 24 or 48 hours. Hypodermoclysis of Ringer's solution and infusion of intravenous glucose are employed as indicated. Blood transfusion is also employed according to the usual recognized indications. The general idea in mind is to disturb the gastro-intestinal tract as little as possible to give the patient maximum rest to have the stomach clean to keep the fluid intake normal—between 3,000 to 4,000 cubic centimeters daily—and to augment the blood when there is need.

Twice on the day preceding operation if possible and once just before going to the operating room the teeth are brushed with a mixture of equal parts of talc and soda bicarbonate. The mouth rinsed with an alkaline mouth wash and then the teeth and gums are painted with a 50 per cent alcohol solution containing 1 per cent each of brilliant green and crystal violet (Barwick's dye). As a result of this treatment there has been a notable decrease in the postoperative respiratory complications.

## ANESTHESIA

A preliminary hypodermic of morphine sulphate -015 and scopolamine -0003 is given to all adults one half hour before operation. Nitrous oxide and oxygen anesthesia alone is used and is satisfactory unless too much manipulation and exposure of viscera is performed. Ether in combination with the above gases is then added and frequently is so employed for the closure of the abdominal wound.

## TECHNIQUE OF GASTROJEJUNOSTOMY

The location upon the stomach for the site of the gastrojejunostomy is chosen as the most dependent portion close to the greater curvature or just opposite to the excised ulcer of the lesser curvature. The transverse colon is now lifted sufficiently to make the mesocolon taut and an opening is made through the latter by knife blade

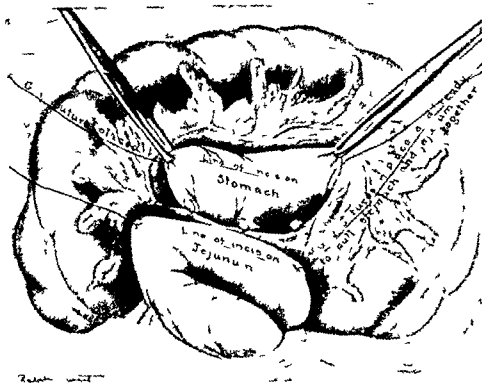


Fig 1 Method of attaching mesocolon to stomach and guy sutures in place

dissection The chosen portion of gastric wall is pushed through and a form of holding clamps light weight Allis is now gently applied to the gastric wall and held by the assistant The mesocolon is attached to the portion of the stomach that will eventually be posterior to the gastrojejunostomy, by suturing with fine catgut into the stomach wall and tying over a small portion of the mesocolon (see Fig 1) The jejunum which had previously been located is placed alongside the stomach The portion of jejunum 7.5 centimeters (3 inches) from its emergence through the base of the mesocolon is usually the desired point for anastomosis

Guy sutures of gastro-intestinal suture No. 1 are now taken through the stomach and jejunum at either end of the site for anastomosis and a Kelly hemostatic forcep applied to the ends of each respective guy suture The Allis forceps are removed and the assistant holds the guy sutures up and out so as to give proper exposure A small portion of gauze packing or a Mikulicz abdominal tape is then placed behind the proposed line of anastomosis

The outer or posterior layer of suture is begun at one end and after tying two knots a clamp chosen uniformly so as to serve as a definite marker applied to the short end A continuous Lembert suture with occasional locked stitch and two locked stitches at the end is applied

Incisions through the gastric serosa, muscularis, and submucosa are made These incisions are effected with the point of the knife so as to expose but not sever the prominent blood vessels These blood vessels are then ligated on each side with black silk B on milliners' needles A non absorbable suture is used here and is so used

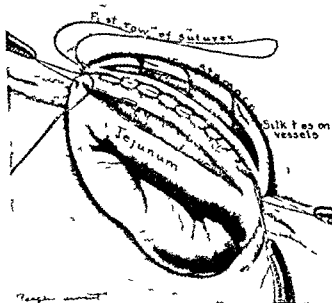


Fig 2 Outer posterior continuous suture placed with its short end marked by a special hemostat Ligation of the main transectable blood vessels of the stomach with black silk B

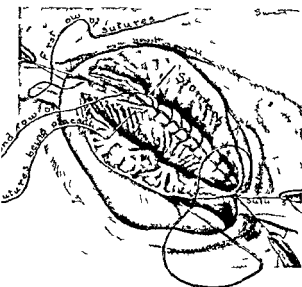


Fig 3 Inner posterior continuous suture beginning at center and placed in locked manner

because of its size flexibility and the fact that it will eventually be turned completely into the lumen and soon sloughed. The blood vessels are cut and the mucosa opened. Should bile tend to leak from the jejunum, a gauze strip of packing may temporarily be employed. The stomach as a rule never leaks because the holding of the guy sutures up and out causes the cut sides of the stomach to approximate in a valve like action. The protruding mucosa is rarely amputated but on the contrary is adjusted to its normal place with each suture. If desired one may explore the stomach digitally from within before further closure is effected.

The inner layer of suture is begun at the middle of the posterior side. A gastro intestinal suture with a needle at each end is preferred. A locked stitch across the entire posterior wall is employed as it gives added assurance of hæmostasis and leaves the mucosa in a smoother and more uniformly apposed manner. As each end of the anastomosis is reached the type of suture is changed to a continuous Connell with an occasional locking on the inside of the lumen. This suture is ended at the center of the anterior wall and the knot invaginated.

The original outer or posterior suture layer is now continued in the form of a continuous Lembert stitch occasionally locked and finally tied with the end upon which the marker clamp had been placed. The guy sutures are next tied but before being cut are employed to hold out the stomach so that the mesocolon can be attached

anteriorly to the stomach wall in the manner previously described. The guy sutures are utilized therefore as additional support to the weakest spots of the gastrojejunostomy.

During this operation as in all major surgical work the patient is simultaneously being given a hypodermoclysis of Ringer's solution in the mesial side of the thighs. An average of 1 000 cubic centimeters and as much as 2 000 cubic centimeters is at times so administered to the patient.

#### POSTOPERATIVE CARE

The patient is allowed postoperatively to assume the position of comfort unless there is some indication otherwise. He is allowed either hot or cold water in teaspoonful amounts as soon as he is awake. He may hold ice in his mouth. The following day 18 to 24 hours postoperatively, he is allowed plain water, alkaline waters, orange juice and weak tea in small amounts, gradually increasing the amount until on the second day postoperatively he is taking at a time any quantity desired. On the third day he is allowed soft palatable food as well as cooked gruel, soft boiled or poached eggs, toast, custards, baked or mashed potato purees, gelatine dishes, etc.

Emphasis is placed upon the fluid intake and output. This is accurately kept and charted. A total of 3 000 cubic centimeters per 24 hours for the average adult is the desideratum. Ringer's and normal salt are employed subcutaneously and glucose 10 per cent or 5 per cent intravenously.

Should the patient have continued emesis then interrupted or continuous gastric lavage is main

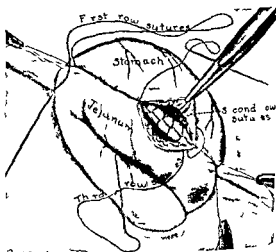


Fig 4 Inner anterior continuous suture applied according to Connell a continuous mattress type and ended at the center anteriorly

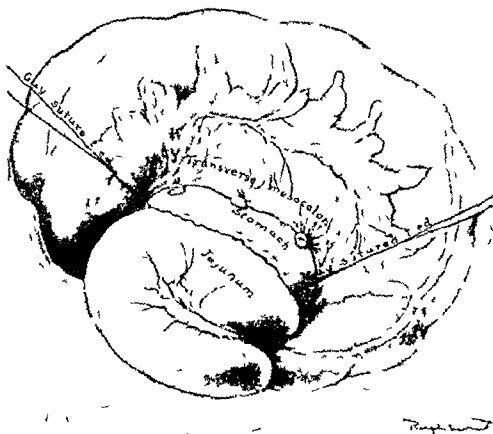


Fig 5 Completion of the outer anterior suture. Tying of the guy sutures. Attachment anteriorly of the mesocolon to the stomach wall.

tained by use of the Jutte tube and Connell suction pump. This tube is passed via the nostril and may be left in place for 4 to 5 days without any great discomfort to the patient.

For postoperative distention, the rectal tube change of position and hot abdominal stupes with protection to the wound dressing is the routine. Lnmata are avoided especially if any likelihood of peritonitis exists. Morphine to give the patient rest is preferred. The bowels, as a rule, move without stimulation on the fifth to sixth day. Liquid petrolatum one tablespoonful twice daily thereafter until the patient is up and about is the usual treatment.

The patient is allowed to be up on the twelfth day and to leave the hospital on the fifteenth day. He returns to his usual vocation unless contra-

indicated on or about the sixth week postoperatively. His postoperative care as regards diet is followed for approximately 6 months. All patients are examined with the X ray and test meal approximately 5 weeks after operation.

#### CONCLUSION

After the employment of this technique for a period of two and one half years in all forms of gastroenterostomy we are convinced of the decreased trauma and the increased ease over that technique where compression clamps are used. The postoperative results are excellent both as to function, which is in part dependent upon judgment as to the type of surgical treatment needed and to the lack of any sequelae such as gastrojejunal or jejunal ulcers.

## A NEW UPPER ABDOMINAL INCISION

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The Sloan Clin.

IN the earlier days of abdominal surgery if the prime end of life saving was attained little attention was paid to the abdominal incision. Incisions were made at various angles and in various directions depending in most part upon the operator's idea of the best manner in which to approach the objective field through the shortest and most direct incision.

With asepsis came the fashion of the longer incision and closer and keener attention was paid to the ways of making and closing the wound. Operators became more daring and easy access to the parts to be attacked became the chief consideration. The longitudinal incision was adopted by many abdominal operators and gained almost universal popularity. Careful and skillful closure of the long incision was thought to secure against the remote as well as the immediate unfortunate results of abdominal surgery. The importance of gaining free access to the underlying structures outweighed all considerations as to ventral weakening. Close and accurate suturing of the peritoneum was supposed to prevent as much as possible the formation of postoperative adhesions underneath the old incision. But it was taken for granted that in the majority of cases adhesions would form underneath the scar.

## PROBABILITY OF POSTOPERATIVE HERNIA

Prolonged observation however showed that any transverse division of muscular or fascia fibers leaves a permanent and irremediable weakness at the site of division that close suturing may be followed by firm union for months or even years but that in time at least some stretching of the cicatrix will certainly take place. Transversely severed fascial or muscular fibers cannot be united in any way that leaves a permanent closure as strongly united as before operation. Gradual weakening of the scar will inevitably occur. Almost as many postoperative hernias become evident during the tenth year following incision as during the second year.

## INCIDENCE OF POSTOPERATIVE HERNIA

According to Southam (9) out of 29,000 abdominal operations 596 (2 per cent) were performed for the repair of postoperative abdominal hernia. According to Boeckmann (1), Abel's statistics from German clinics had shown 8.9

per cent hernias after longitudinal incisions with healing *per primam* and 31 per cent after healing *per secundam*.

## DIFFICULTIES IN CLOSURE OF LONGITUDINAL INCISIONS

Quoting Quain (8) All those who have made a number of gall bladder operations through longitudinal incisions in tense abdominal walls will remember instances in which it seemed impossible to make a satisfactory serosa to serosa closure of the peritoneum because of the lateral pull on the so called posterior sheath of the rectus muscle. Sometimes the suture would cut through the peritoneal margin again and again until there was no hope of making a smooth closure of the frayed up edges. Finally a few stitches were probably placed far out into the rectus muscle in a desperate but vain effort to overcome the difficulty and to leave no raw surface facing the viscera.

In the hands of many operators this manner of opening the abdomen is chosen solely because of its fancied convenience to the operator and without due consideration of the fact that in every longitudinal transrectal or pararectal incision irreparable damage may be inflicted on the patient.

## RELATION OF LENGTH OF INCISION TO INCIDENCE OF HERNIA

The old rule that the danger of hernia with longitudinal incisions increases in proportion to the square of the length of the incision seems to be borne out in our experience. Thus in a given number of operations if there were nine hernias with 3 inch incisions there would be 16 with 4 inch incisions and 25 with 5 inch incisions. Over 80 per cent of the patients that we have seen with 10 year old 5 inch scars from upper abdominal incisions have had some appreciable and demonstrable weakening of the abdominal wall at the site of the old scar. Over 60 per cent of those with scars 4 inches long and 10 years old have had appreciable weakening of the abdominal wall at the site of the old incision. 27 per cent of those who have 3 inch 10 year-old scars have had definite evidence of weakening of the scar while less than 5 per cent of those who have had incisions shorter than 3 inches have such evidence.

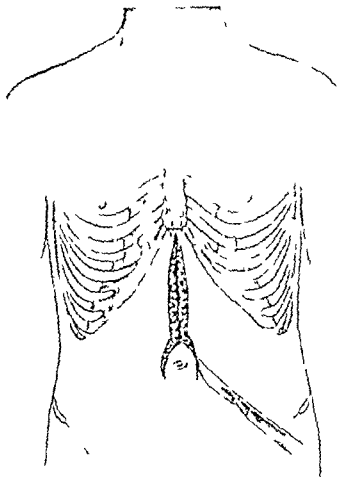


Fig. 1 An incision through the skin and fat down to the fascia from the ensiform to a point 3 centimeters above the umbilicus and continued outward and downward on each side of the umbilicus to a point 4 centimeters below the umbilicus on either side leaving a V-shaped piece of skin and fat around the umbilicus

With the longitudinal incision, the transverse fascia fibers are severed and must be coapted in such a way as to remain in close apposition for from 10 days to 2 weeks for union to occur.

The tensile strength of aponeurosis like that of the transverse aponeurosis of the abdomen is enormous. Every time that the intra abdominal tension is increased by coughing, vomiting, or straining the tension thrown directly upon the stitches or sutures holding the ends of severed transverse aponeurotic fibers together is enormous.

McArthur (4) has called attention to the fact that the transversalis muscle is a muscle of respiration and its median attachment is subjected to strain with each respiration. Following a longitudinal incision this strain obviously must be borne by the sutures.

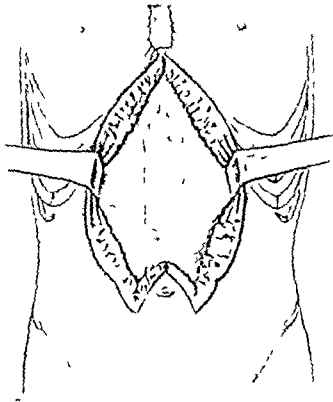


Fig. 2 Dissection outward of flaps of skin and fat exposes the aponeurosis over the inner borders of the rectus muscles

#### METHOD OF MEASURING THE RELATIVE VERTICAL AND LATERAL TENSION

By measuring the tension with spring scales attached to several forceps, the force required to bring the ends of the severed transverse fibers together following a longitudinal incision while the patient is lightly anesthetized can be estimated. By the same procedure, with a transverse incision in which the rectus muscles have been cut transversely, one can arrive at a somewhat accurate estimation of the amount of force required to bring the layers of the abdomen together vertically.

In the same way with an L-shaped incision, one side of which is longitudinal and one transverse, the lateral and vertical force required for closure can be accurately measured.

*Rule for estimation of the tension upon the suture line following a longitudinal incision.* The longer the longitudinal incision the more force is required to bring the ends of the fibers of the divided aponeuroses together. The force required increases in proportion to the square of the length of the incision. Thus, in a 3 inch longitudinal incision, immediately after the incision is

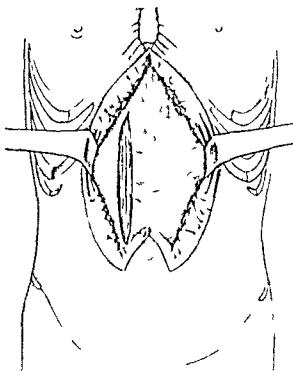


Fig 3 Vertical incisions are made through the external sheaths of the recti about 1 centimeter external to their inner borders. Upon the length of those two incisions will depend the amount of exposure that it has been possible to obtain.

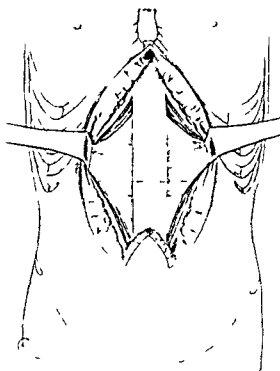


Fig 4 The rectus muscles with the overlying external sheath fat and skin are rolled outward and held by suitable retractors exposing the posterior sheath of the recti. Dotted lines indicate locations that may be chosen for the transverse incision through aponeuroses and peritoneum.

made and before the oblique muscles have retracted the aponeuroses perhaps about 30 pounds of pull will bring the aponeuroses together during light anaesthesia while in a 4 inch incision it will require nearly 50 pounds to bring the ends of all the aponeuroses together. If the incision is lengthened to 5 inches it will require about 80 pounds with the patient in the same degree of anaesthesia. Therefore we seem justified in formulating the following rule. The lateral pull upon the suture line following a longitudinal abdominal incision is in proportion to the square of the length of the incision.

*Estimated relative amount of tension upon the suture line with longitudinal and transverse incisions.* So far as we have been able to determine, when complete relaxation is not present the lateral abdominal tension is about thirty times as great as the vertical. If this is correct the strain upon the suture line of a longitudinal incision is thirty times as great as that upon the suture line of the transverse incision.

Not only that but as has been pointed out by Farr (7), the distance between the pubis and the

ensiform can be shortened by suitable posture and the 'relaxed abdominal wall relieved of all vertical tension. Should the sutures hold throughout the entire length of the longitudinal incision and the severed ends of the transverse fascia fibers be held in apposition until healing is complete the risk of hernia is lessened, especially the immediate risk. But it goes without saying that the thin strip of scar tissue is quite inadequate to bear up under the original strain. This thin scar is under tension every hour of every day as long as the patient lives. It is well known that scar tissue under strain will gradually lengthen and weaken. Therefore, some weakness will invariably follow.

#### MUSCLE SPLITTING INCISION IN THE LOWER ABDOMEN

It has long been recognized that the danger of hernia, especially the remote danger is of enough actual importance to the patient to make it of prime importance that some method be devised by which this danger can be eliminated. It has been evident to many surgeons of large experience

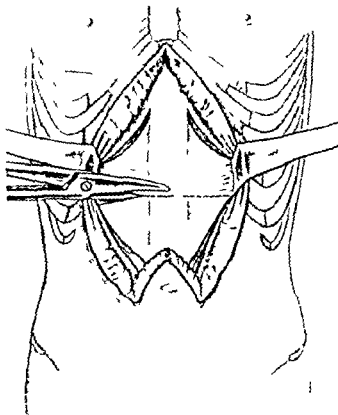


Fig 5 After the retractors are in place and the sheath of the rectus exposed a transverse incision is made through the exposed posterior reflection of the sheath of the rectus and the peritoneum

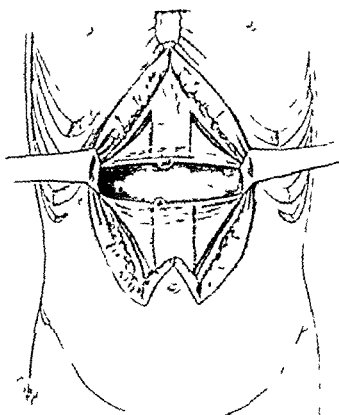


Fig 6 The incision is extended across the linea alba parallel to the direction of the fibers of the aponeuroses from the outer edge of one rectus muscle to the outer edge of the other

that this can be done only by making the lines of incision through the different structures *parallel* with the direction of the most important fibers. This result has been accomplished in the lower abdomen by the development of the Pfannenstiel incision.

Kustner (3), a German gynecologist, in 1890 recommended a transverse incision in the lower abdomen. In the same year Rapin, a Swiss gynecologist reported the use of the same incision and recommended it most highly.

*The Pfannenstiel incision in the lower abdomen.* Pfannenstiel (6) in 1900 presented in quite an elaborate manner the advantages of the combined transverse and longitudinal incision in the lower abdomen. In the same year, Stimson, of New York, and Hartmann, a French surgeon, independently began using the same incision. In 1907 Pfannenstiel reported a total of 700 pelvic operations through his incision. Pfannenstiel claims a 4 per cent reduction in mortality, with a larger percentage of healing by first intention than with the longitudinal incision, and elimination of the danger of hernia.

Kroenig and Menge, in 1903, published reports commending it from the same standpoint. Stimson (11) in 1904 reported 150 operations with this incision. Wanscher, a Danish gynecologist and Hennricus and Engstrom, Finnish gynecologists, reported favorable results from this incision in 1909.

*Proved advantages.* Many men in the United States were active in recommending the Pfannenstiel incision in the lower abdomen during the period from 1905 to 1909. Walker, of Detroit, being one. In the same year, 1909, Eduard Boeckmann (1), of St. Paul, published quite a complete review of the literature extant along with his results in four hundred operations. All testified to its great advantages in the prevention of hernia and several surgeons reported reduction of the incidence of postoperative abdominal adhesions by its use.

The Pfannenstiel incision modified to meet our needs has been used routinely in our clinic for all pelvic operations since 1909. We are convinced that from the standpoint of the patient's welfare it is far superior to the longitudinal one. The



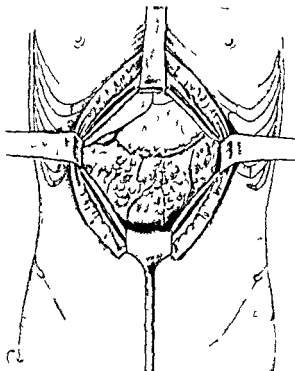


Fig 7 Retraction upward and downward afford an opening with a diameter about equal to the length of the incisions in the anterior sheaths of the rectus muscles

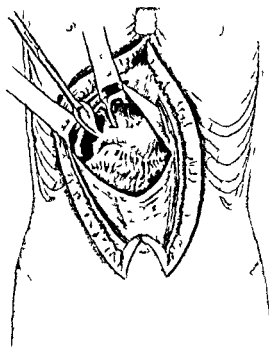


Fig 8 Retraction upward and out ward afford access to the gall bladder region The opening can be retracted over the regions of the spleen or appendix also

dangers of postoperative hernia and separation of the wound margins are eliminated. The convalescence is shortened and postoperative discomfort is markedly lessened.

*Sprengel's transverse upper abdominal incision.* In 1910 Sprengel (10) published a description of a transverse incision in the upper abdomen and reported its use in a number of cases with excellent results. Moschcowitz (5) of New York Farr (2) of Minneapolis and many other writers have reported results with the transverse incision in the upper abdomen and testified to some of its undeniable advantages over the longitudinal one. It affords ample room for access to all organs in the upper abdomen. It is easily closed and according to some surgeons followed by almost no danger of postoperative hernia. The nerve supply of the abdominal wall is not interfered with. Its lack of popularity may be due to the fact that most of us have a prejudice against severing such large muscles as the recti.

*McArthur's incision.* In 1915, McArthur (4) published a description of his combined vertical and transverse incision for operation upon the gall bladder. The usual paramedian incision is made through the right rectus muscle and the

fibers of the aponeurosis of the transversalis are separated transversely. He emphasizes the fact that the transversalis is an active respiratory muscle and following a longitudinal incision with each respiration it so tugs and pulls on the line of sutures as to make it give away. By separating the fibers of the aponeurosis of the transversalis instead of cutting them this cannot occur. With this incision there is danger of destroying the nerve supply to the median portion of the rectus muscle and adequate exposure for approach to the stomach, appendix or spleen is not afforded.

#### POSTOPERATIVE ADHESIONS

A consideration however of greater importance than that of ventral or postoperative hernia is that of postoperative adhesions to the under surface of the scar. Moschcowitz (5) in discussing the closure of the longitudinal wound from the standpoint of postoperative intra abdominal adhesions says

Very frequently however almost unsurmountable difficulties arose especially in the application of the first suture line. In most of our operations, particularly if the patient is very obese or very muscular the suture of the pen-

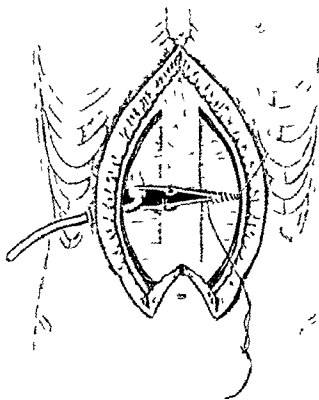


Fig. 9 In cholecystostomy the drainage tube is brought out through a puncture wound and the gall bladder is brought to the abdominal wall at any point desired

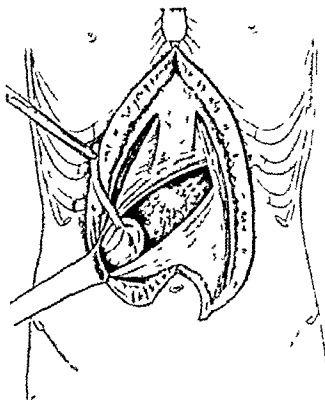


Fig. 10 The appendix is more readily dealt with through this incision than through a high right rectus incision of any reasonable length

toneum is extremely difficult. The stitches tend to cut through to overcome this tendency one is inclined to include more tissue in the bite of the needle unfortunately, this procedure not only does not mitigate the difficulty, but actually increases it.

After a great deal of trouble, and with considerable loss of temper, the surgeon finally succeeds in finishing the suture line, the result however, is not satisfactory, the suture line is weak, and there are generally present also a number of smaller or larger holes, which permit the prolapse of small bits of omentum. In the great majority of the cases this suture line is so precarious that its protective value is nil. It is, of course possible that it acts as a prophylactic to the formation of adhesions, by preventing contact between the intraperitoneal viscera and the extraperitoneal tissues. But even this is, I believe, illusory, as in the secondary operations that have fallen to my lot, I have found the adhesions to be so massive as to lead me to suspect that the suture line gave way upon the first strain, and not only permitted, but actually invited the contact which it was presumed to prevent. In this connection it is of great interest to know that Sprengel found

at autopsy, in a few cases which died shortly after a laparotomy through a vertical incision, that the peritoneal suture line had completely separated.

"In a very large number of cases even this flimsy closure was impossible, and after vainly trying to fortify the first suture line by including a part of the rectus, the attempt at a layer suture was very frequently given up in disgust, and the wound had to be closed practically *en masse*, the first suture line including the entire thickness of the abdominal walls, with the exception of the skin. I have often said on such occasions that by far the most difficult part of my operation upon the gall bladder or biliary passages is the closure of the abdominal incision.

Adhesions from destruction of nerve supply. Quain (7) in a very exhaustive report of the results of an experimental study says "An analysis of the results of the fifteen experiments in which trauma, or trauma plus irritation or infections, was applied on the parietal peritoneum shows that in eight the adhesions (seven omental and one hepatic) were confined to the side of nerve extirpation, two of the three cases having adhesions on both sides of the linea alba had more extensive

the recti. It is easily made and gives ample exposure for all operations in the upper abdominal region, such as operations upon the stomach, spleen, liver, gall bladder, colon, etc. It permits approach to the appendix and affords opportunity for exploration of the entire abdomen. If it is found necessary to operate upon the pelvic organs, they can be approached through a Pfannenstiel incision in the lower abdomen.

*Description of the incision.* An incision is made through the skin and subcutaneous tissue down to the aponeurosis extending from the ensiform to a point 3-5 centimeters above the umbilicus. It is continued outward and downward on either side of the umbilicus to a point on either side about 4 centimeters below the umbilicus, leaving a V-shaped piece of skin and subcutaneous tissue around the umbilicus. A flap of skin and fat dissected outward exposes the aponeurosis over the inner borders of both rectus muscles. Then vertical incisions are made through the external sheath of the recti about 1 centimeter lateral to their inner borders. Upon the length of these two incisions will depend the amount of exposure that is obtained.

The recti with the overlying external sheath and skin are rolled outward and held by suitable retractors. A transverse incision is made through the exposed posterior sheath of the rectus and the peritoneum and extended across the linea alba parallel to the direction of the fibers from the outer edge of one rectus muscle to the outer edge of the other. Lateral and vertical retraction affords an opening with a diameter about equal to the length of the incisions in the anterior sheaths of the recti. The only blood vessels encountered are some small ones in the fat and one or two in the falciform ligament near the linea alba. With care no bleeding from blood vessels in the recti occurs. No important nerves are cut. This gives ample approach for all operations in the upper abdomen. The opening can be retracted over the regions of the gall bladder, spleen, or appendix.

*For operations on the gall bladder.* Retraction upward and outward affords access to the region of the gall bladder, liver, and hepatic flexure of the colon. For cholecystectomy or cholecystotomy, the right half of this incision is all that is usually required. An evident advantage is the ease with which one half of this incision can be converted into the larger one. When cholecystotomy is performed, the drainage tube is brought out through a puncture wound and the gall bladder is brought to the abdominal wall at any point desired.

*For appendectomy.* Retraction downward and outward affords access to the region of the appendix. The appendix is more readily dealt with through this incision than through a high right rectus incision unless it be of unreasonable length.

*Closure. Posterior sheath and peritoneum.* The closure of this incision is quite simple as the transverse fibers have not been severed. If the closure of the peritoneum and posterior sheaths of the recti is begun at the outer ends of the transverse incision, no difficulty is experienced even with the largest and fleshiest patient as no tension whatever is required to bring the edges together.

*Closure of anterior sheath.* Even with the longitudinal incision there is rarely any difficulty in coapting the edges of the anterior sheath of the rectus muscle if the posterior sheath has been well brought together. In fact when the posterior layer has been brought together, the abdomen is closed and tension is taken off of all other structures with this incision the posterior sheath falls together and has its original strength. The rectus muscle is firmly attached to its anterior sheath but not to the posterior. During straining, vomiting, or coughing, contraction of the rectus pulls the flap of the anterior sheath inward and relieves the suture line of strain. Therefore there is no appreciable tension upon the sutures placed in the anterior sheath. The skin and fat flaps fall together with surprising readiness. In fact, skin clips are all that are required to hold the flaps of skin and fat together, and the scar is a fine line much superior to that of the usual incisions.

It may require a very little more time to open the abdomen by this route. However, much time is saved in the closure and much difficulty is avoided. All authorities agree that even with deep anaesthesia and complete relaxation, difficulties are sometimes encountered in the proper closure of the posterior fascial layer with a longitudinal incision. With this incision the lateral pull on the sutures is entirely avoided and such complete relaxation is not necessary.

*The presence of sepsis.* This incision is of great advantage when an infectious process requiring drainage is present. In 72 of our 114 cases operated upon by this method, 7 of which were septic cases, drainage was instituted through the transverse incision of the posterior sheath and brought out through the rectus muscle, anterior sheath, and skin by a stab wound. Three septic cases were drained through stab wounds placed above the incision. In 4 cases of perforation from ulcer of the stomach, the drainage was brought out at

the inner edge of the rectus through this incision. In one case of multiple abscesses in the liver, drainage continued for 7 weeks, yet at this time, 2 to 18 months after operation, only one patient of the series shows any evidence of hernia.

#### CONCLUSIONS

The apparent advantages of this incision are: Almost complete absence of tension on the sutures of the posterior fascia layers reduces the probability of postoperative adhesions to the abdominal scar. The danger of wound separation and hernia is almost entirely eliminated.

Ample exposure is afforded for all operations in the upper abdomen.

Four fifths of the postoperative discomforts following longitudinal incisions are prevented.

Closure is accomplished with great ease. Gas anesthesia is sufficient, deep anesthesia is not required. Convalescence is shortened, and a better scar is secured.

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AVULSION OF THE DIAPHRAGM<sup>1</sup>

BY W A BRYAN M D F A C S NASHVILLE TENNESSEE

A LIMITED search has failed to reveal in the literature a case similar to the one under discussion. Rupture of the diaphragm and congenital defects resulting in herniation are numerous enough. So far as investigation has gone they seem due to rupture through the body of the diaphragm or to the escape of abdominal viscera through the normally weak points. The case in hand, while allowing escape of abdominal contents into the pleural cavity, was purely an avulsion. Numerous articles and case reports are to be found dealing with the so-called eventration of the diaphragm which also has no semblance to this case.

Mr D Y D age 40 stopped his truck on the highway in front of his home and was about to change a casing. He saw a bus and a car coming in opposite directions at a rapid rate toward him and because he feared they would collide near him he took the casing aside his yard and in a standing position with the body bent forward was examining it.

The cars came on full speed and when the bus driver saw that a collision was inevitable he chose to avoid it by leaving the road. The bus passed through the fence and either a headlight or a fender struck the man in the left chest knocking him down and moderately contusing the soft parts over the sixth seventh eighth and ninth ribs in the midaxillary line. No ribs were broken.

A physician was called found the man in extreme agony and administered one fourth grain of morphine hypodermically without perceptible relief. He then brought the patient to a small hospital where he received another quarter grain of morphine. On reaching the hospital about 2 hours after the accident I was shown a skiagram of the chest (Fig. 1) which presented some very puzzling aspects upon a little study the conclusion was reached that only a ruptured diaphragm and escape of stomach into the left pleural cavity could account for the replacement of lung shadows with a sac of much lighter density containing no markings except its very definite outline. The upper border reaching almost to the clavicle and for the displacement of the heart to the right.

The patient was then seen and examined. His agony continued unabated. His countenance was anxious respiration labored abdomen rigid board like constant nausea and efforts to vomit were present but without result. His attendants said that this had been continual since the injury nothing ever being raised. The right side of his chest expanded abnormally on inspiration the left



Fig 1 Roentgenogram of chest showing lung high in left pleural cavity

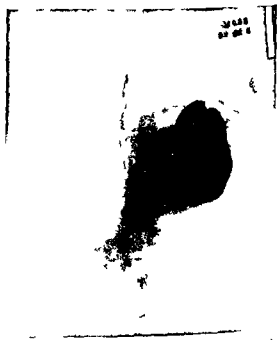


Fig 2 After patient had swallowed a small amount of barium. The course of the esophagus is easily seen.

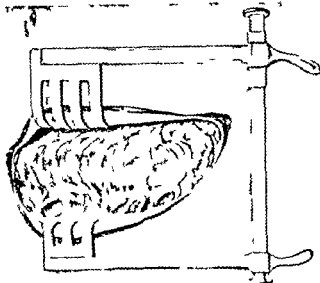


Fig. 3. Colon and omentum presenting in the wound when chest was opened.

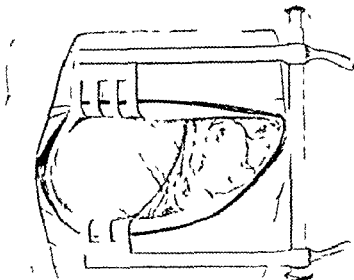


Fig. 4. Showing stomach after retracting, colon downward to left.

side not at all. The lower margin of the ribs seemed to be pulled slightly downward and to contract rather than to expand on inspiration; the intercostal spaces did not become depressed. The heart was displaced to the right of the midline. The whole left chest was tympanic; this was more clear cut in the upper chest. The man when not retching was crying for water. He could swallow water without difficulty and the tinkling sound of its entrance into the stomach could be heard most clearly in the apex of the axilla and in the subclavicular fossa. The pulse was 120, respiration 25, blood pressure 108-65.

On account of the gravity of the condition I felt that I could give him a better chance by removing him to Vanderbilt Hospital and operating there. Consent to this was given.

On reaching Vanderbilt Hospital the X-ray examination of the chest was repeated with an identical result. He was then given a small amount of barium stirred in water which showed the stomach to be in the chest cavity and also showed the course of the esophagus downward, curving sharply to the left and then upward. This was indicated by a faint light streak which should have if it had been seen in the early examination of the plate, given me and my consultants a better understanding of the actual state of affairs. Unfortunately this curved white line was seen only after we knew the relation of the structures in the chest. The barium that was swallowed entered the stomach and accumulated in a pool on the posterior wall.

The question then arose as to whether operation should be undertaken immediately. On account of the possibility of dire complications and with a fair pulse and blood pressure it was considered that immediate operation would probably give him the best chance.

The anæsthetic was gas and ether.

An incision 7 inches long was made in the left seventh interspace. When the pleura was opened omentum was encountered first, covering both large and small intestine behind and internal to these was the stomach (Fig. 3). Passing the hand into the chest we could move the stomach downward into the abdominal cavity; the outline of the opening between the two cavities could not be determined. An effort was made and repeated several times to replace the viscera into the abdominal cavity; in every instance it proved futile. The difficulty of replacing the

viscera was due in part undoubtedly to the fact that the patient could not be relaxed by the anæsthetic. (I have had one other diaphragmatic injury in which the same observation was made although he received only ether.) As soon as partial reduction was accomplished the organs would escape from the grasp on the least motion and rush back to the top of the chest as if under intense suction. The stomach was so tightly distended with gas that a trocar and cannula were inserted to collapse it. It re-filled in a few minutes and aspiration was necessary a second time. The cannula was employed instead of the stomach tube because gas anæsthesia was administered. I am unable to state what influence the reversed action of respiration on intragastric pressure may have had on the accumulation of gas in the stomach. Schlippe has called attention to the fact that intragastric pressure rises normally with inspiration, but when the stomach lies in the pleural cavity the reverse is true. Consequently it became necessary to open the upper abdomen, making an incision 6 inches long just to the left of the midline. While my first assistant pulled the viscera down and out I made pressure above. Replacement was easy, but as soon as the stomach was released it promptly returned to the top of the pleural cavity.

When the abdominal organs were reduced to their cavity it was found that the diaphragm had been avulsed from its attachment to the left chest wall at a distance of about 10 inches (Fig. 4) that no vestige of it had been left attached to the wall so that passage from pleural cavity to abdominal cavity was just as smooth as if no partition had ever been present. That this large wing of diaphragm had curled up into the chest cavity with the esophagus circling around its under surface and the free edge of the diaphragm ragged about 3/4 inch thick with a projecting ledge of pleura above and of peritoneum below extended anteroposteriorly across the pleural cavity, mediastinum to its right (pleural) surface abdominal viscera to its left (peritoneal) surface. This position gives an explanation of the patient's ability to swallow and inability to vomit for the fixation of the esophagus below and the high elevation of the fundus caused a bend of the esophagus at the cardia to an acute angle which easily admitted entrance to and quite as effectively prevented exit from the gastric cavity.

Within the pleura the lung was high, internal collapsed. There was about a pint of dark blood in the pleural cavity.

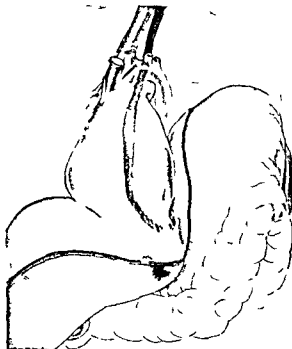


Fig 5 Showing the free margin of the diaphragm to the right of the stomach and the placement of the thoracic viscera.

No bleeding vessels were discovered. Practically the whole stomach, the transverse colon, the great omentum, the spleen and numerous coils of small intestine were in the pleural cavity.

Upon reduction of the viscera and discovery that instead of being ruptured the diaphragm was avulsed a new problem presented, namely that some plan must be devised to suture a free edge to a flat wall. It did not require long to conclude that it could be done only with through and through mattress sutures (Fig 5). In this way the diaphragm was brought into contact with the chest wall and held. The sutures were passed through skin and chest wall into the pleural cavity through diaphragm again through diaphragm through chest wall. They were tied on the skin side. Because of the ease with which omentum insinuates itself into very small crevices left after suture of the diaphragm these sutures would be efficient, require close apposition if indeed they could be made to hold at all. I had no precedent for this method of closing the rent but can imagine no substitute for it. James F. Mitchell operated on a diaphragmatic hernia in which he thought direct approximation insecure because he could not insert the sutures far enough from the edge. Consequently he dissected the skin up on one side of the incision and inserted sutures through both limbs of the rent in the diaphragm and the chest wall.

The wounds in chest wall and abdominal wall were now closed. The patient died shortly after the work was completed before he was removed from the table.

Postmortem could not be obtained.

The nearest approach to this case is diaphragmatic hernia or rupture. Surgeons choose one of the three possible methods of approach for closure

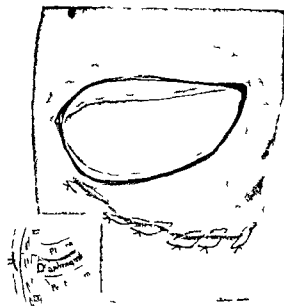


Fig 6 Mattress sutures holding margin of diaphragm against inner surface of chest.

of these openings, the abdominal, the thoracic and the two combined. Judging from the assurance with which the former two groups recommended the route of their choice, one must consider that there are cases in which the chosen routes were satisfactory. Those who recommend the combined route as I have shown in the case reported have most meritorious reason for insisting upon this plan, because reduction could not be accomplished and closure made by the single route. It seems that this should be the rule in large openings with escape of large portions of viscera into the pleural cavity, and that if with either of the single routes reduction should prove difficult, no time should be lost in further efforts but that a companion wound should be made at once in the abdomen or chest respectively. Such delay and the attendant efforts at reduction can not fail to increase shock and mortality.

The question naturally occurs, *post facto* whether, if this man had lived, the union of the diaphragm to the chest wall would have been secure enough to withstand the tension imposed by coughing, sneezing or heavy straining and since there is doubt in my mind on this point I am sure that in a similar case the mattress sutures should be heavy silk or linen instead of chromic catgut. Would the ordinary respiratory movement of the diaphragm not interfere with such healing as in other parts of the body where constant or repeated traction of muscles on sutures is

an almost certain guarantee of failure? This traction of course, could be avoided by doing a phrenicotomy, the only disturbing factor being the rhythmic rise and fall of the paralyzed leaf on inspiration and expiration. This, if it accomplished union, would do so at the cost of permanent loss of 300 or 400 cubic centimeters of lung capacity.

The tendency for intra abdominal viscera especially omentum, to insinuate themselves into any crevice on the diaphragm raised a doubt whether the origin of this muscle could possibly be sutured so closely as to prevent this accident, which, if it should occur, would mean failure.

It has been demonstrated that the lateral portions of the diaphragm which lie in contact with chest wall heal more surely than the rest of it, and that wounds heal more readily when they are parallel to the muscle fibers than when transverse. It has even been claimed by Iselin and also by the Brazilian Repetto that they could in no instance obtain union of wounds transverse to the fibers in the dog's diaphragm. Naegeli disputes this, claiming that the chief causes of failure are accumulation of air, serum or blood in the pleural cavity, or anything that prevents contact of the lung with the parietal pleura.

It is interesting to conjecture why this peculiar accident occurred under circumstances which usually, one might almost say normally, should

result in rupture of the diaphragm. The causes of rupture of the diaphragm are given as sudden pressure or blows upon the chest or abdomen, and the result is rupture not avulsion. Something unusual, some extraordinary group of factors must have combined in this case to cause severance in the thickest, strongest and most extensive line to be found in the midriff, namely along its peripheral attachment, or its origin from the chest wall. It seems as if it must have been sheared from its attachment and I think this is precisely what happened, that the lungs were filled with air, the man saw he would be struck and very naturally braced himself by tightening every muscle of his body. This included both abdominal muscles and diaphragm, the latter contracted under heavy tension in its horizontal plane, bolstered above by the overfilled lung, below by abdominal viscera. The edges of the distended lung reached downward nearly or quite to the angle between chest wall and the diaphragm. The blow came like a flash, the lung was compressed and forced to expand along the line of least resistance and the sharp edge of the lower lobe virtually sheared the diaphragm from its moorings. In other words while neither of the forces could have produced such an injury the combination of traction fixation and shearing served effectively to convert the most resistant part of the muscle into the weakest.



## SUPRAPUBIC PROSTATECTOMY

COMPLETE EXPOSURE THROUGH A ONE AND ONE QUARTER TO ONE AND ONE HALF INCH INCISION OPERATIVE RESULTS AND TECHNIQUE<sup>1</sup>

BY S HARRY HARRIS M.D. CH.M. (SYDNEY) F.C.S. (A) SYDNEY AUSTRALIA

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**S**UPRAPUBIC prostatectomy since its wide popularization by Freyer has been the subject of endless discussion. At different times and in different clinics innumerable variations and modifications of technique have come and gone. In the past most of the operations have been of a blind nature being performed entirely by touch unaided by vision. Lately the trend has been decidedly toward the performance of an open operation the field being more or less completely visualized. The very wide incisions practiced by some surgeons both at home and abroad admit almost a complete daylight exposure.

Were it the sole desideratum this wide exposure would doubtless be the choice of most operators. Many other factors however must be taken into account of which the most important are (a) primary wound union (b) postoperative pain (c) limitation of respiratory movement and (d) abdominal distention.

On each of these counts the new wide exposure compares unfavorably with the old blind operation through a small incision. This latter operation however presents so many obvious disabilities that it is rapidly falling into desuetude.

The operation which I have devised and practiced now for several years aims at a combination of the good points of both and the bad points of neither. It allows a complete visual exposure through a one and a quarter to one and a half inch incision and is applicable to both one and two stage operations.

During the 13 years ending December 13, 1926 the operation described has been performed with some important variations 433 times with 16 deaths within 1 month after operation a mortality rate of approximately 3.6 per cent. In the last 4 years and 10 months of this period there were 245 operations and 7 deaths a mortality rate of approximately 2.8 per cent. There has been also during this period a very marked corresponding improvement in both immediate and remote results.

All cases are now subjected to a one stage prostatectomy when it is practicable. Preliminary bladder drainage is effected preferably by a retention catheter, if renal function is defective. In the

occasional case when catheterization of any kind is either impossible or intolerable and when sufficient improvement does not follow catheterization a temporary suprapubic cystostomy is done commonly through a 1 inch transverse incision. The glass tube which is habitually employed for drainage of the bladder (Fig. 11) is replaced about the sixth day by a Pousson self retaining rubber catheter.

The second stage is deferred for several weeks until the patient has regained a reasonable measure of health and is able to walk about without effort.

In no case is prostatectomy undertaken whatever the other findings, unless the indigocarmine test is deemed satisfactory. For this purpose 4 cubic centimeters of 4 per cent solution are given by intramuscular injection or 4 cubic centimeters of 0.8 per cent solution intravenously.

The postponement of the second operation for at least 1 month after the first has several advantages. It obviates the long confinement to bed necessitated by the performance of the two operations in rapid succession, and with the disappearance of wound rigidity permits with slight variation of the usual technique (Fig. 1) almost as ready visualization of the field as obtains in the one stage operation.

From experience it may be definitely stated that equally as good exposure of the prostatic environs is obtainable through the small incision described as through a larger and any procedure indicated in this area is with the technique described equally as readily carried out. If during the course of the operation conditions arise which demand a wider exposure it is a simple matter to enlarge the incision to any desired extent. In my experience however this is rarely necessary.

## OPERATIVE TECHNIQUE

Suprapubic prostatectomy under intrapharyngeal or intratracheal anaesthesia was carried out in practically all the cases of this series. The so called intra urethral method of enucleation of the prostate which leaves the verumontanum and ejaculatory ducts intact was the procedure of election.

The bladder is washed out with 1:3000 solution of nitrate of silver emptied as completely as possible and the catheter removed immediately before the patient is brought to the operating theatre.

The patient is placed in a low Trendelenburg position and a transverse suprapubic incision made through the skin and fat varying with the obesity of the patient from  $1\frac{1}{4}$  to  $1\frac{1}{2}$  inches in length. The aponeurosis is slit vertically in the midline for a similar distance. The rectus muscles are separated and the bladder picked up with tissue forceps. The peritoneal reflection is pushed up to the topmost point of the bladder successive pairs of forceps being applied to the bladder wall until this point is reached when only the highest pair remains. The bladder is now drawn well up into the incision and acts as an effective plug should per chance, any residuum of lotion or urine escape during the next step (Fig. 2).

The bladder is incised between the forceps by careful layer dissection until the mucous membrane is reached. This is picked up with dissecting forceps and nicked to an extent sufficient only to allow the immediate insertion of the nozzle of an electric suction tube (Fig. 3). When the bladder is completely empty the suction tube is removed and the incision lengthened to admit 2 fingers. There has been no soiling of the wound by urine or lotion.

Careful digital exploration and if deemed advisable visual inspection of the bladder is next



Fig. 1. Vertical incision 1 inch in length employed when there has been a preliminary cystotomy. This provides adequate exposure with the technique described.

made and calculi if present are removed (Fig. 4).

Bimanual enucleation and removal of the prostate are then proceeded with.

With proper arrangement of sheets and towels and the use of three gloves on the left hand which are successively removed by an assistant when

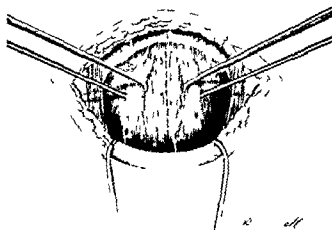


Fig. 2. Bladder exposed, ready for incision. Peritoneal reflection well shown.

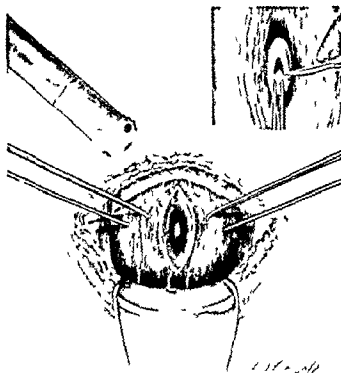


Fig. 3. Layer dissection of bladder. Nozzle of sucker ready for insertion. Inset. Method of cutting mucosa.

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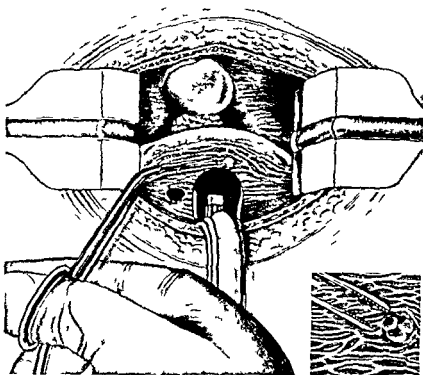


Fig 4 Author's electrically lighted bladder retractors in position. Anterior retractor omitted for the sake of simplicity. Nest of small calculi seen in deep post prostatic fossa. Inset Removal of calculi from diverticulum shown in main figure (enlarged)

soiled no contamination of the operative field takes place, even after manipulation entailing removal and reinsertion of the first and second fingers of the left hand into the rectum.

The electrically lighted bladder retractors, which I have had constructed are now placed in position. These consist of a set of 6 of which are generally used in any given case. They vary in size, shape, and length. The longer blades are necessary when we are dealing with obese patients with deep pelvis. All have the Thompson Walker type of handle and are electrically adapted and interchangeable. These permit a thorough inspection of the bladder neck. This is carefully reviewed and any necessary trimming performed (Fig 5).

After bleeding has received any requisite attention (*vide infra*) the single extended figure-of-eight suture of No. 3 plain catgut is placed (Fig 6) to embrace, in order, the cut edges of the bladder, the fibrous and muscular coats of the bladder, and finally the rectus muscles and aponeurosis.

The special glass bladder drainage tube (Fig 11) is then inserted and the suture drawn tight and tied (Fig 7).

The operation is now complete: the tube snugly filling the abdominal wound (Fig 7 and 8). Occasionally a Michel clip may be placed with advantage in the skin on one or the other side of the flange of the drainage tube.

The dressings are applied and the glass drainage tube fixed firmly in position by zinc oxide strapping placed outside the dressings in such a way that the glass connecting tube may, if necessary for the removal of clots, be disconnected from the rubber piece on the top of the bladder drainage tube without disturbing the dressings.

**Control of hemorrhage.** When special measures for operative control of hemorrhage were necessary, which was exceptional, bimanual compression usually sufficed. In some cases suture of the bladder neck was practiced; in others the prostatic cavity was packed with 3 inch sterile gauze which

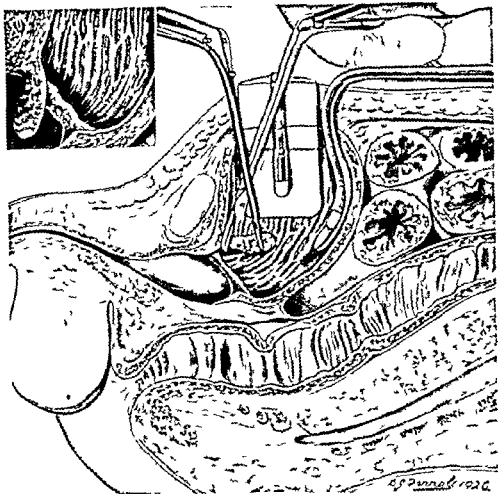


Fig 5 Sectional view. Removal from anterior region of sphincter of adenomatous nodule discovered during systematic review of prostatic cavity after prostatectomy. Inset. Enlarged view of nodule in natural position.

was removed in 1 to 3 days depending on the attendant discomfort. Suture of the bladder neck was found to be of such value that it is now used as a routine in both the one and two stage operations. It is of importance, both for immediate hæmorrhage and to ensure satisfactory after results, that a complete clearance be made of the prostatic cavity and bladder neck, and that the roof, that is to say, the region of the vesical sphincter or trigone, should be enabled to fall in on the prostatic cavity without tension. Thus when a small tight sphincter or a considerable remnant of slack in the trigonal region remains after the removal of the prostate, it is deeply divided backward in the midline, one stitch being placed by a special needle which I have had constructed (Fig 10), in each side of the incision, as shown in Figure 9, to prevent reunion of the cut edges. If a thick, fleshy trigonal shelf is present a wide wedge is cut out and the edges sutured. Furthermore, unless these precautions are adopted "collar" or "ledge" formation is liable to occur and

lead to persistence of obstruction or its recurrence at a later date.

The omission in the "blind" operation of these precautions and the impossibility of their observance is definitely associated with increased liability to hæmorrhage, both immediate and remote, to sepsis, and to delayed closure of fistulæ. These, indeed, constitute in the main the *raison d'être* of the new operation.

Instruments of a particular type are essential for the accurate and facile performance of this work, through the restricted incision described (Figs 4, 5, 9, and 10). Most of these have been specially constructed for me in Sydney.

#### POSTOPERATIVE TREATMENT

Half a pint of salt solution is given per rectum immediately after the patient is returned to bed and a bandage fixed in position to ensure scrotal suspension. A hypodermic injection of morphia grain  $\frac{1}{6}$  is given as the patient is regaining consciousness and repeated as often as required.

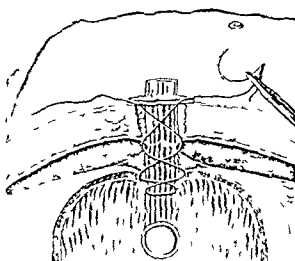


Fig. 6 The single extended figure-of-eight suture used for wound closure before being tied

The patient is propped up in bed as soon as complete consciousness is regained

On the morning of the fourth day after the operation 1 ounce of castor oil is given by mouth and 6 ounces of warm olive oil run slowly into the rectum. No further rectal manipulation of any kind is permitted during the first fortnight of convalescence

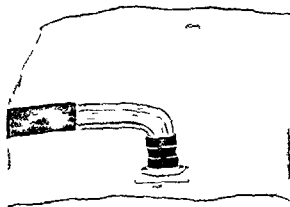


Fig. 8 Operation completed through 1.4 inch incision which the tube snugly fills. No skin sutures required

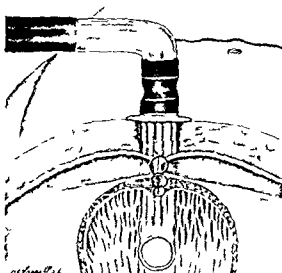


Fig. 7 Suture drawn tight and tied. Glass drainage tube 3/4 in. caliber in position. Operation complete

The abdominal dressings are changed if necessary after 24 hours. After this they rarely require attention until the removal of the bladder drainage tube about the sixth day. The removal of the tube leaves a clean red granular sinus which rapidly collapses in most cases allowing the skin edges to fall together. A linear scar generally not more than 1 inch in length results and to all

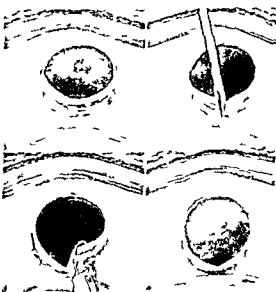


Fig. 9 Redundant tissue in trigonal region after prostatectomy showing method of biopsy and suture



Fig. 10 Author's bladder neck suture needle. This is an adaptation of Lane's cleft palate needle and is longer and more slender than Young's boomerang modification ( $\frac{7}{8}$  size).

Fig. 11 Author's glass bladder drainage tube ( $\frac{1}{2}$  natural size).



intentions and purposes, also a normal abdominal wall. Patients are generally out of bed on the tenth day. No bladder irrigation of any kind is employed at any rate during the first fortnight beyond a superficial irrigation of the sinus immediately following removal of the drainage tube. After this if the urine is "dirty" and has failed to respond to the usual hexamine and sodium benzoate catheter irrigation of the bladder with nitrite of silver is practiced for a few days.

**Onset of micturition.** On the second day after the removal of the tube patients are given a urinal and encouraged to make effortless attempts at micturition 3 or 4 times daily. The large majority succeed by the eighth to the twelfth day and are quite "dry" from 3 to 7 days later. Should no urine be passed by the fourteenth day, a steel sound is passed. As a matter of interest it may be stated that there were 4 among the first 160 cases who despite the sounding failed to pass urine and in whom on the seventeenth day a rubber catheter was tied and left for 2 days. All were nervous feeble old men and in none was there any other apparent reason for the delay. In no case of recovery in this series was the onset of micturition delayed beyond the twenty first day, in 1 only beyond the nineteenth.

#### CONCLUSIONS

The methods described admit of a complete clean cut, visualized operation, and present 1

venture to think several novel features, the details of which have been planned to enable a maximal exposure with a minimal amount of trauma. The discomfort following operation is thus very largely obviated and wound healing expedited.

The operation while doubtless presenting greater technical difficulties than those usually performed and requiring an armamentarium of and a certain familiarity with instruments of a special type will I believe by its decreased mortality and morbidity rates well repay the meticulous care demanded in its performance. With experience the complete operation can be performed in from 15 to 30 minutes and with so little disturbance that the convalescence in most cases resembles that of a minor operation and might possibly seem incredible to one who has not observed the results.

A fairly lengthy experience with the plan of campaign outlined shows that shock, sepsis, uræmia, and pneumonia almost can be excluded as operative risks. Hemorrhage will still very occasionally require attention. There remains the cardiac or vital factor, practically the sole indefinable risk. Gradual or rapid circulatory failure from the seventh to the twenty first day when it occurs, is in my experience the most fatal of all complications. It is in effect the end of life. When or whether it will supervene in any of these old men none can certainly foretell.

## ILEOCÆCAL INTUSSUSCEPTION IN INFANTS WITH SPECIAL REFERENCE TO FLUOROSCOPIC FINDINGS

By VIRGIL R. STEPHENS, M.S., M.D., BERWYN, ILLINOIS

UP TO the present time X ray studies in acute intussusception in infants have been very meager. This may be due to the relative infrequency of the condition as suggested by Meyer and Brams in a review of cases in Cook County Hospital Chicago in which only 6 operative cases of intussusception were tabulated from the records of the last 6 years. Clubbe of Sydney Australia however publishes a series of 2,0 personal cases by far the largest number in any report available. The high mortality still attendant upon this condition suggests the need of more attention to the early diagnosis and treatment. Clubbe reports a mortality of 20 per cent, Smith 40 per cent, Birkenfeld 30 per cent, Gibbon 10 per cent.

A few attempts have been made to make use of the fluoroscope as an aid in the diagnosis of acute ileocæcal intussusception. Regnier states that up to the time of his report in 1924 ileocæcal invagination had been demonstrated by opaque enema but twice, the first instance being Lehmann's case in 1914 and the second that of Muff. Muff describes a fluoroscopic picture showing a barium column flowing without interruption to just beyond the splenic flexure, and at that point a shadow extending from the normal colon to the right side of the spinal column which could only have arisen from the small bowel. Regnier's case was that of a 13 year-old girl with onset of symptoms 2 weeks previously. The opaque meal showed stenosis proximal to the invagination and absence of the cæcum and colon. The barium enema showed division of the contrast medium into two cylinders corresponding to the inner and outer lumen of the intussuscepted area. Distally, an outer cylinder was characterized by a thin mantle like deposit with circular stripes showing a distended colon with deep haustra and less than normal space between. Proximally, a small caliber cylinder corresponded to the intussuscepting portion.

All of these cases, however, were older children and young adults and the examination was made several days after the onset of symptoms.

Birkenfeld states that the X ray findings are characteristic and explains them by referring to the work of Muff, Regnier and Lehmann. Grise suggests that the fluoroscope may show a cone

shaped column near the intussusception but gives no illustrations. Abt states that X ray examination should not be made on account of the incident trauma unless the diagnosis is uncertain. He says that the enema ends abruptly in an outline suggesting that of the apex of the intussusception its sheath presenting further evidence of the nature of the obstruction. Just what the appearance is he does not definitely state.

The writer has operated on 6 cases of ileocæcal intussusception in infants under 1 year of age with 1 hospital death. The fatality occurred on the seventh day following operation and was preceded by a series of convulsions and the general picture of acidosis. There was no evidence of recurrence.

Autopsy was not permitted. According to Birkenfeld death usually occurs within the first 2 days. He had no mortality after 6 days in over 50 cases.

Fluoroscopic examination with an opaque enema was made in 3 cases with very gratifying results.

CASE 1. Baby D. M. age 3½ months observed 6 hours after the passage of blood from the bowel had a very definite sausage like tumor on palpation but had had no colic. On account of the unusual clinical picture this case was reported.<sup>1</sup> When the barium mixture reached the upper sigmoid it took on a wide concave posterior surface meeting the intussuscepting bowel with two definite horn like projections as the barium insinuated itself around the so-called outer cylinder. When more barium was allowed to flow this presenting column traveled orally at a rather rapid rate until it reached the hepatic flexure maintaining practically the same contour on the presenting surface. A second palpation revealed no tumor in the epigastrium. Immediate laparotomy showed the intussusception to have been reduced as far as the hepatic flexure by the barium mixture.

CASE 2. R. J. a boy of 11 months had bloody stool 3 hours before examination and beginning colic 11 hours before. The contrast medium flowed rapidly until it was about two thirds of the way across the transverse colon when the concave presenting surface appeared. A film taken a minute later verified the observation. No reduction was accomplished nor attempted in this case. Immediate operation verified the position of the invagination, parts as seen in the roentgenogram (Fig. 1).

CASE 3. A. J. a fat male infant of 10 months was brought to the hospital 4 days after a sudden attack of colic and referred to me by Dr. F. C. Becht. The symptoms had consisted chiefly in the vomiting of almost all food taken and there had been two loose stools passed on

<sup>1</sup> See Stephens in Bibliography.



Fig 1 Baby R J male age 11 months 11 hours after the beginning of colicky pains. Showing barium enema column meeting the intussusception in the transverse colon.



Fig 2 Baby A J male age 10 months. No sausage tumor palpable. Onset 4 days previously. Showing barium enema meeting intussusception at the hepatic flexure.

the day of entrance the last being slightly streaked with blood and mucus. The child did not appear acutely ill and the symptoms of obstruction were conspicuously absent. No tumor mass could be palpated. On fluoroscopic examination with barium the enema ascended rapidly to the hepatic flexure where the typical outline appeared. Increase of pressure produced evidence of pain but failed to advance the column. The barium was allowed to escape which it did almost immediately with only a few sprinkles remaining in the bowel. The injection was repeated with the reproduction of the same picture. Films were made while the enema tube was held in and the back pressure kept up. Laparotomy was advised on the basis of the X ray findings and revealed the intussuscepting mass occupying the ascending colon. The colon was lying snugly against the right lateral wall of the abdomen and therefore could not be palpated. The small bowel was collapsed showing that obstruction may be of low grade for several days after invagination has taken place. The reduction was easy and there was no necrosis. This patient probably would have succumbed with a diagnosis of colitis had not the fluoroscopic picture given the correct interpretation of the situation.

No "inner cylinder" of barium was observed in any of these cases. This finding of Regnier may have been the result of the opaque meal which had previously been given. At any rate no barium enters the inner lumen during the first few minutes after injection.

The characteristics of the fluoroscopic picture as observed in these 3 cases were

1. An enlargement of the caliber of the barium column as it approached the intussuscepting mass.
2. The definite tendency toward the formation in the opaque medium of a concave presenting surface with pointed edges. This was true whether the force was sufficient to move the intussuscepting mass backward or not.
3. A thin, somewhat cone shaped sprinkling of barium in front of the concavity which probably corresponds to the so called "mantle" of Regnier and represents the advancing rim of the barium cylinder. The main facts are illustrated in the accompanying roentgenograms (Figs 1 and 2).

It would appear that the fluoroscopic examination should be of diagnostic value in cases with doubtful history or physical findings. It may be of service in partly or wholly reducing the intussusception and at the same time proving the result.

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## A NEW AND PRACTICAL ABDOMINOSCOPE

BY W O SWILK MD FACS IHOIINI ARIZONA  
St Joseph Hospital

**F**AILURE to make a correct diagnosis in abdominal conditions is still the cause of many deaths. The ineffective X ray has been of some help to the clinician but the exploratory laparotomy is still too frequently performed. It is for the purpose of giving the diagnostician visual access to the peritoneal cavity that this instrument was devised. This instrument is of value to the surgeon in every abdominal operation. He is able to visualize the abdominal condition and place his incision accordingly. It is valuable in splanchic block with local anæsthesia, it gives an opportunity for careful inspection of the abdominal contents without disturbing or dragging upon them. It makes appendectomy in interval cases a simple procedure requiring a one half inch puncture wound.

The technique of using the instrument is simple. A one half inch incision is made to the right or left of the midline, approximately one inch. All oozing and bleeding is controlled before the peritoneum is opened by a sharp pointed hæmostat or scissors according to the technique of the operator. The instrument is then inserted left in the abdomen for a few minutes until the patient is accustomed to its presence and all abdominal reflex action ceases. If the patient is under a general anæsthetic the surgeon can proceed at once with his examination. It gives a visual field in the form of an oval (2½ by 2 inches) which is sufficiently large for all purposes. It can be used in all cases of doubt in which an exploratory operation would be required to make a decision and it should be used as a routine procedure in all abdominal operations as it permits inspection of many of the inaccessible areas now examined by palpation by the surgeon's hand which in most instances is about as good from the outside as it is from the inside.

We are using this instrument at present in every abdominal case as it helps us place our

incision, thereby shortening the length of the incision. It also enables us to place the incision more accurately and obtain a far more accurate knowledge of abdominal pathology than we would possibly obtain by any other method.

The largest diameter of the tube is 1 centimeter and the length of the tube is about 32 centimeters. The instrument consists essentially of a tube about the diameter of a fountain pen about the outside of this tube there is another tube of very thin material which slides freely upon the first tube and which is actuated by a screw with a

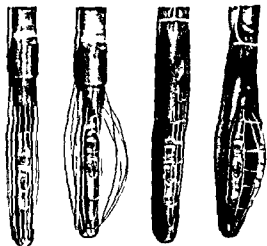
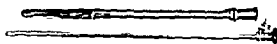


Fig 1 (Above) Instrument as enabled ready for use  
Fig 2 Shows the detail of the distal end  
Fig 3 The distal end expanded  
Fig 4 Instrument inserted in gloved finger  
Fig 5 Instrument expanded

large knurled nut at the upper or outer end of the instrument. When this nut is turned, the outer tube is moved along on the inner one and engages first the center one of the small slides near the lower end of the instrument. This slide is thus moved along in its groove and the spring wire, which is hinged in the slide and also at the extreme end of the instrument, is thus bent outward into a slight arc. As the outer tube is further moved, it engages another slide on either side of the center one and thus two more wires are bent, although to a lesser extent than the center one. Further movement engages two more wires and they move and bend as the others do but to a still lesser extent. When the outer tube reaches the end of its travel, the several wires have formed an inclosure about the lower or inner end of the instrument and at no place, are the wires sufficiently far apart to allow easy entrance to the inclosure. The nut may then be withdrawn and the whole mechanism returned

to its original cylindrical shape. The wires are so hinged at each end that they work in guides which hold them in alignment and, at the same time, prevent the possibility of anything becoming pinched under the wires when they are flattened out.

The whole instrument may be easily and quickly taken down for cleaning and as quickly reassembled. It may be boiled or sterilized without in any way affecting its operation.

Inside of the instrument proper, a straight cystoscope is inserted and lighted and by this means the entire inner area of the inclosure may be minutely inspected through an opening in the tube.

We are using this instrument routinely and find it of immense value. Mr. R. T. Evans who worked out the details of this instrument and perfected it has so thoroughly completed his task that the instrument works easily and smoothly and is most durable and efficient.

## THE USE OF THE OVERHEAD SUSPENSION IN TREATMENT OF FRACTURE OF FEMUR IN INFANTS

By H. D. SONNENSCHEN, New York  
From the Surgical Service, Harlem Hospital, New York.

THE care of fractures in the majority of instances does not usually come under the care of the surgical specialist. Only in the larger cities is it possible to segregate and hospitalize the fracture cases. The standard of results obtained will therefore depend upon the technique possible for the average physician to employ.

The extremes of age are productive of the two extremes in the results of fracture surgery: the best results being obtained in infants and children while the poorest results occur in the aged.

In the treatment of fractures in both the infant and the aged the nursing and medical attention is of great importance and often of the most importance if the best results are to be secured. The physician concentrating his efforts on the local injury is apt to overlook this fact, and yet it is the apparently small details conducive to the child's health and well being which contribute largely to the successful recovery, not only of the local condition but also of the growth, nutrition, comfort, and mental welfare of the child. The child is naturally happy and all means to keep it so must be paramount in the minds of those responsible for its care. Fortunately infants and children react favorably to trauma. Their recuperative and reparative processes are at a maximum. Except in the more severe type of injury and if no head or abdominal injury is present they recover promptly from the primary shock. They are often more frightened than hurt.

Several other important factors must be borne in mind in the treatment of fractures occurring in infancy. It is well to remember that perfect anatomical alignment is not essential. Persistence of a certain amount of deformity is a less serious matter than it is with adults. In the course of a few years such deformities tend to be corrected by the process of growth; slight angulation can easily be corrected in the after treatment by means of the convalescent brace. This must not be interpreted to suggest carelessness and neglect in the handling of the local condition, but only to encourage simplicity in the treatment. Above all unnecessary and meddlesome manipulations must be avoided. Open reduction has no place in this type of fracture. It is never indicated.

With this in mind the local treatment should be so instituted as to allow for the general care of the patient, the feeding so important in the very young, and the local and general hygienic care which will keep the infant normal and hasten the ultimate recovery.

Several problems present themselves more annoying than serious. Infants are constantly coiling themselves and the retentive apparatus. Their skin is extremely sensitive to irritation and infection. Their inability to comprehend, combined with their restlessness, disturbs the position of the splints. It is not unusual for children to remove a splint or plaster cast. They do not appreciate the seriousness of their condition and we cannot expect the co-operation seen in an older child or adult.

Fractures of the femur occur in infancy as a result of indirect violence usually due to a fall and are invariably of the shaft. Cases have been reported as occurring during manipulative operative procedures. The majority of our cases occur in the spring and summer at this time of the year the children are out of doors because of the heat and humidity and frequently fall off fire escapes and porches. The fracture is usually complete, transverse or oblique though some may be of the greenstick variety. A case of separation of the lower femoral epiphysis in an infant 3 months old has been seen by the writer. It has not been our experience that rickets, malnutrition or constitutional disorders predispose an infant to fracture. This communication does not include any discussion on the pathological fractures that occur as a result of deficient calcium metabolism such as those that are seen in osteomalacia and fibrocystic disease of the bone.

The first step is to decide which particular closed method should be used. Only about four methods are described in most textbooks: (1) the plaster of Paris spica, (2) the Thomas plate with adhesive traction, (3) the padded wood side splint, and (4) overhead vertical suspension.

There are many methods and it is plainly evident that none is entirely satisfactory. There are many advocates for one as there are for the other and it therefore becomes a question of experience and results.

Briefly, the objections to the plaster-of-Paris method of treatment is that it is uncomfortable and is more so if poorly applied. There is the likelihood of secondary displacement occurring within the cast. The cast becomes soiled and requires renewal. It does not allow the child enough freedom to move about in bed. Then too not all surgeons are adept in the handling of the plaster of Paris.

The Thomas splint is most useful in adults. It is unexcelled as a transportation splint. With infants, however, this splint is not really satisfactory, the ones on hand are usually too large, and even if specially made, there is the possibility of the ring becoming soiled with urine and feces; this with the counter pressure on the tuberosity of the ischium causes excoriations and pressure sores.

The long side splint is unstable, it becomes soiled, also does not allow for traction. The patient will disturb the position of this splint and even remove it. This is also true of the Thomas splint.

The overhead vertical suspension method overcomes all these difficulties, combining the true fundamentals in the treatment of fractures, namely, reduction of the deformity, traction and immobilization without absolute fixation. Vertical suspension aids lymphatic and venous drainage and adds to the comfort of the patient.

Except for a few simple changes, the method we use is the one originally described by Bryant. With a child properly suspended in the overhead frame, the general care of the patient is greatly facilitated, this is one of the outstanding features. The child cannot soil the apparatus, and its needs can be taken care of. A Bradford frame can be used in conjunction with the overhead suspension, but we have not found this necessary. In this position the limb is more easily radiographed. The frame is simple and easily constructed.

Many methods and modifications of the Bryant overhead suspension are employed, but simple measures have proved best. The apparatus we use is easily and inexpensively made by any carpenter, or if needs be, by the physician himself. It consists of two uprights, supporting a cross piece, two pulleys are attached at the center of the cross piece. A pulley is also attached to each upright, to carry the weights outside of the bed and away from the patient. Just enough weight to lift the buttocks off the bed should be used. This facilitates the use of the bed pan. Unless the child is unusually large, we have found that the average weight to use is about 5 pounds. It is better to suspend both legs, if only one leg is

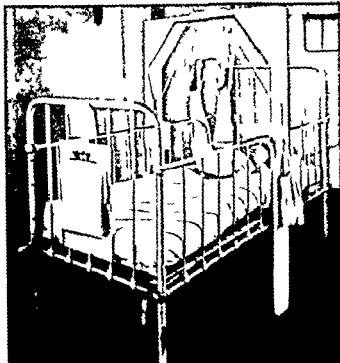


Fig. 1. Infant with fracture of left femur suspended in overhead frame.

suspended, infants squirm, turn and twist, and in this way disarrange the traction. With both legs suspended traction is more certain and constant. If the child is too unruly or is one who keeps twisting and turning around, a cross bar uniting the two spreaders can be used. We are now using this cross bar as a routine measure. There is probably little choice as regards fixed or pulley traction, it is a matter of choice or custom. We have been in the habit of using pulley traction, as it accommodates itself better to changes in position assumed by the child than does fixed traction.

Traction strips are applied to the mesial and lateral aspects of the thigh and leg, extending from 1 to 2 inches above the line of fracture to below the foot, incorporating a wood "spreader" below the foot, which is wide enough to keep the adhesive from chafing on the malleoli, and to the center of which is attached the light line for traction. Only the best quality moleskin adhesive should be used, the edges of the adhesive should be nicked, to allow for smooth conformation to the skin surfaces. No preliminary preparation of the skin, except perhaps ordinary cleansing is necessary. The crest of the tibia, the knee, and the head of the fibula should be protected with cotton padding. Additional fixation is secured by spiral adhesive strips over these lateral strips. A firm circular bandage covers all

The child is left suspended from 3 to 4 weeks at which time union is usually solid. There is a very rapid formation of callus. Even at the end of 1 week because of this callus it is difficult to change the position of the bones. After the removal of the suspension the child is kept in bed for another 1 or 2 weeks and weight bearing is allowed at the end of 8 weeks. With the average case no convalescent brace or apparatus is needed. Occasionally if the callus is not entirely firm, if slight angulation remains or if we are dealing with a too unruly youngster a short plaster-of-Paris spica or walking caliper can be employed.

Our patients are wheeled out on to the porch and also are given a cod liver oil preparation daily. Such factors as fresh air, sunlight and avoidance of infection are essential to the child's well being. The child may have the benefit of sunshine during the greater part of the day, weather permitting, if the bed is moved from time to time directly into the most sunny location. As a substitute we suggest the use of the quartz lamp and this judiciously used has proved of great value in hastening convalescence.

All the cases are carefully checked up with measurements and radiographs. Local massage and physiotherapy are unnecessary. In none of our cases has there been any limitation of the joint motion. It has never been necessary to remove the child from the frame even though some of the patients developed complications such as measles, diphtheria and bronchopneumonia.

For an analysis of 63 cases of fracture of the femur in infants we were able to obtain a complete report from 2 to 10 years following admission to the hospital. The overhead traction was used in all cases. The ages of the patients ranged from 4 months to 2½ years and the sex was about equally divided. The average stay in the hospital was 36 days.

Fracture occurred in the right femur 33 times in the left femur 29 times and in both once making a total of 63.

Firm, bony union with good in fact almost perfect alignment was obtained in 61 cases. Two patients had bony union but with slight angulation; this was later corrected with a caliper brace. Excellent functional results with no shortening were obtained in 61 cases. Two patients were discharged with shortening of one half inch. On later re-examination this shortening had been compensated for.

#### SUMMARY

1. The frame is simple and easily constructed.

2. Not everyone is equipped to use plaster-of-Paris or make a suitable sized Thomas splint. This frame or even modifications utilizing its basic principles can be used.

3. The motion allowed causes enough irritation to stimulate the formation of callus.

4. Radiography is made easy.

5. With compound fractures this method allows for easy approach to wounds for dressings.

## THE COCCYX—ITS DERANGEMENTS AND THEIR TREATMENT

By PHILIP LEWIN, M D CHICAGO

HAVING learned very little clinically about the coccyx in medical school and never having seen a student or interne whose experience was different, the writer is tempted to write this short clinical note. Textbook descriptions are not as a rule, satisfactory.

The coccyx represents the remains of the an throipoid tail, for which reason it is often referred to as the "tail bone." Its function in man is to afford attachments to muscles. These do not suffer however, by its removal.

The anatomy of this region is briefly as follows. The coccyx consists of four segments joined together, making a cone shaped structure which articulates above with the sacrum forming the sacrococcygeal joint. Four important muscles attach to the coccyx viz the gluteus maximus posteriorly, the coccygeus anteriorly, the sphincter ani to the tip in front and the levator ani to the tip behind. The sacrococcygeal ligaments are found above. The nerve supply of this region is derived from the posterior divisions of the coccygeal, and second, third, fourth, and fifth sacral nerves plus the anterior divisions of the fifth sacral and the coccygeal nerves.

The most important clinical disturbances of the coccyx are 'dislocation,' ankylosis at the sacrococcygeal articulation, tumors, and disease. The first of these is much more important than the others.

Symptoms of "dislocation" of the coccyx are pain, coccydynia, especially on sitting. Patients

complain of inability to sit through a movie show or a theater performance, of pain while riding horseback, etc. They must squirm and twist to be comfortable. The discomfort is usually more marked while the patient is sitting on a soft than on a hard surface because in the latter instance the weight rests on the tuber ischi but in the former case it may be borne in part at least by the coccyx. There may be pain on defecation, especially if the patient is constipated.

Röntgenograms often reveal no demonstrable pathology, and the surgeon must rely upon the history and physical examination. The history is usually that of a fall and forcibly sitting down or of a blow or kick. It is more frequent in females, many of whom are neurotic. Many patients have tried hot sitz baths and sitting on rubber rings, adhesive stripping of the pelvis etc. with variable relief.

Rectal examination is very valuable. With the patient lying on the left side with knees and hips flexed, the right index finger is inserted into the rectum and the thumb placed over the coccyx outside that structure. If there is abnormal mobility at the sacrococcygeal articulation and accompanying sensitiveness and tenderness, the diagnosis is made.

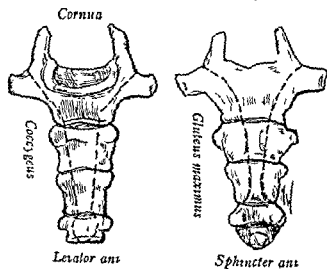


Fig 1 Coccyx and its muscle attachments (Modified from Gray's Anatomy)

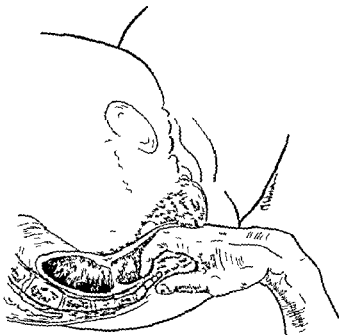


Fig 2 Patient on left side knees and hips flexed. Examiner's right index finger in rectum and thumb outside

The pathological changes are chiefly anatomical but cases of tuberculosis have been reported and tumors, especially teratomata, are found in this region. Many patients with coccydynia have arthritis of the lumbo-sacro-iliac region and it is important to explain that removal of the coccyx does not cure the arthritis higher up. The operative relief in selected cases should be constant.

The treatment is operative. A midline incision is made in the median raphe. With a finger of an assistant constantly in the rectum as a guide, a careful dissection is made and the coccyx is removed at the sacrococcygeal joint. Two or three deep sutures and two or three superficial silkworm sutures and a collodion gauze dressing suffice.

## A NEW METHOD FOR SUBPERITONEAL DRAINAGE

By JOSEPH B. BACON, M.D., F.A.C.S., MACOMB, ILLINOIS

THE following is a proposed method for improved drainage of the subperitoneal space following the primary operation for removal of carcinoma of the rectum by the Coffey method.

When Coffey published his classic operation for cancer of the rectum a wonderful advance was made in rectal surgery and some of our great surgeons expressed the belief that the last word had been written in operative methods for rectal cancer. Experience has taught us however that vertical drainage of the subperitoneal space after the primary operation according to the Coffey technique is not perfect and that it has the same faults that were found in vertical or 'up hill' methods of draining the pelvis in the past when various forms of tubes and drains were in general use.

Why not use the sigmoid when it has been invaginated through the rectum and anus as an aid in securing drainage from the bottom of the subperitoneal space? Its serous lining is aseptic and can be kept so for from 24 to 48 hours until the peritoneal suture line has become secure against general infection of the peritoneal cavity. In the meantime and afterward up to the completion of the second operation, absolutely perfect drainage will be secured.

In order to accomplish this I have had made an aluminum tube 8 inches long and  $\frac{1}{2}$  inch in diameter with a flange at the upper extremity 2 inches in diameter and a plug fitting loosely into the distal end having a rounded ball surface which cannot engage and tear the surface of the sigmoid when passed through it. The tube is curved to follow the sacrum and the flange is so broad that the gauze placed in the sacral and bladder spaces can be packed under the flange without interfering with free drainage.

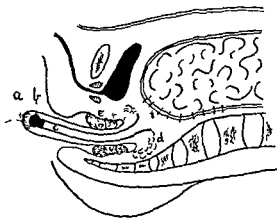


Fig. 1

Fig. 1 a Closed end of inverted sigmoid with inversion tube b plug in end of drainage tube c metal drainage tube d gauze pack e rectal carcinoma f sutured peritoneum

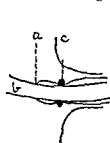


Fig. 2

Fig. 2 a Cauterized end of sigmoid b metal tube c rubber ligature

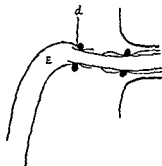


Fig. 3

Fig. 3 d The rubber ligature e the rubber drainage tube

Every detail of the Coffey operation is carried out except that of drainage. When the abdominal wound is closed and its dressing completed, the drainage apparatus is adjusted. First, a rubber band is applied tightly around the sigmoid and metal tube near the anus and the ends tied with a silk or linen ligature. A safe knot cannot be made with rubber. Then with a cautery knife the sigmoid is severed about 1 inch distal to the tight band, and with forceps the distal sigmoid and the ball plug are removed from the metal drainage tube which remains aseptic.

A loosely fitting rubber drainage tube is next passed over the end of the metal tube and firmly secured by another rubber band. Thus a clean siphon is obtained from the subperitoneal space into a jar of antiseptic solution at the bedside.

At the time of the second operation this metal drainage tube can be employed as a handle, and great assistance given in the enucleation of the cancer mass.

One occasionally finds that in cancers of the rectum there is an almost complete constriction but careful examination will reveal that under complete anaesthesia the constriction relaxes and

the soft cancer tissue can be crushed with the finger and an opening sufficient for the passage of the tube easily made. Or if necessary the opening may be curetted gently to a diameter sufficiently large for the passage of the drainage tube. This, of course, is permissible only because all blood and lymph channels have been eliminated at this stage of the operative procedure.

#### SUMMARY

1 The Coffey operation remains the best method of procedure for the removal of rectal cancers.

2 The method of vertical drainage of the subperitoneal space constitutes a serious defect in this operation.

3 A new method of drainage is proposed involving the use of a flanged metal tube extending out through the sigmoid and anus, making an air tight aseptic connection with an ordinary bedside drainage apparatus.

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# THE POSTOPERATIVE CARE OF OLLIER-THIERSCH SKIN GRAFTS ADVISABILITY OF DAILY SURGICAL DRESSINGS

By FLBERT T. RULISON, B.S., M.D., SACRAMENTO, CALIFORNIA

In the September 1941

**S**KIN GRAFTS should not be dressed for from 5 to 8 days unless there is evident suppuration about the grafts. (3)

The time of the first dressing after the operation will of necessity vary somewhat with one's conception of the degree of infection present. In grafts applied to a sterile fresh surface the dressing need not be taken down for 5 days at least, but when dealing with a granulation surface we are in the habit of doing the first postoperative dressing on the third day. (1)

This advice accurately reflects the current conception of the immediate after care of Ollier-Thiersch skin grafts. A careful review of the literature has failed to reveal any reference to daily dressings beginning twenty-four hours after operation. The advisability of early and frequently repeated dressings rests upon the indisputable fact that in most instances following the application of the grafts we are dealing with an exudative contaminated wound and that such a wound requires the utmost surgical cleanliness. The feasibility of the method rests upon the demonstrable fact that the primary dressings may be removed in twenty-four hours or less without disarranging the grafts.

The areas most frequently elected for Ollier-Thiersch grafts are granulating surfaces resulting from deep burns or extensive wounds. Varying numbers of organisms may be recovered from these wounds or from the tissue spaces at the time these surfaces are in 'prime' condition for the transplantation of the grafts. The grafts likewise are not free from organisms in all instances as observation has been repeatedly made that staphylococcus albus is present in the superficial layers of certain supposedly clean epidermis. Inasmuch as abstention from the use of antiseptics is the rule in preparation of these areas from which grafts are taken, the viability of any organisms present is in no way affected. In the case of fresh operative wounds with sterile muscular base the results of skin grafting have always been uniformly excellent. Here we have conditions closely approximating sterility if not actual sterility. It is in the other instances of large granulating surfaces that failures or partial successes are more frequent. Yet it is possible to have complete success quite uniformly in the

latter cases if one but follows the established rules of unremitting surgical cleanliness in the dressing of these contaminated wounds.

The sequence of histological changes occurring in the area of the applied grafts from the time of operation is of interest and importance and further substantiates the contention that these areas may and should be dressed early and often. Briefly these changes are:

1. Formation of fibrin from the plasma present on the surface of the wound and on the under surfaces of the grafts. Expression of serum occurs at the time the fibrin is formed.

2. Period of plasmatic circulation 4 to 48 hours.

3. Primary anastomosis of vessels from wound to graft or the growth of vessels from the wound into lumina of vessels of the graft. This process is complete in 48 to 72 hours. (2)

4. Growth of vessels constituting permanent blood supply into graft fifth to twelfth days. During this time the tissue spaces are flooded with leucocytes dealing with bacteria and disposing of products of degeneration. Growth of fibroblasts is likewise taking place, binding grafts more and more firmly into place. These changes are virtually the taking place in any healing contaminated wound. The only difference is that as a rule the contaminated wound presents a breach in continuity of tissue with forces of repair advancing from either side, while the skin graft must depend upon the forces of healing advancing from but one side.

The method of postoperative care to be described takes cognizance of these several changes. At the time of transplantation it may be observed that within a period of 5 to 10 minutes the graft becomes lightly anchored to the wound surface. It will withstand considerable lateral pressure without moving. This is due to the formation of fibrin, the wound cement which is to function also as a matrix, permitting the so-called plasmatic or lymph circulation and supporting budding endothelial cells of the newly forming blood vessels destined to nourish the graft. The grafts are placed so that there is a margin of 1 to 2 millimeters between them for the escape of serum and the leucocytic exudate which will certainly form. This detail is at variance with the advice

usually given to overlap the grafts. The overlapping of the grafts was devised to prevent their disarrangement and hasten eventual healing but does not take into consideration proper drainage which is so essential in a contaminated wound. These narrow uncovered margins rapidly epidermatize and the matter of maintaining the grafts in place may be dealt with by means of efficient wound splinting.

Freshly grafted areas call for the application of a smooth, non cohesive material. Strips of thin gutta percha tissue or plain cellosilk serve the purpose admirably. This material should be sterilized by scrubbing with soap and water, soaking for 2 hours in 1 to 4,000 solution of bichloride of mercury and should then be thoroughly rinsed in sterile water and placed in 4 per cent boric solution. Strips roughly 1 to 1.5 centimeters in width are applied criss cross leaving narrow spaces between the strips for escape of exudate. The strips should be long enough to extend 2 or 3 inches beyond the wound margins. In this way the grafts are splinted and securely anchored in position.

The next point of importance is the application of a highly absorbent, mildly antiseptic gauze dressing. A moist boric dressing of sterile used-gauze of four thicknesses made up in rolls of 5 yards, and 6 to 8 inches in width is applied in a circular or spica fashion. Appropriate splinting with molded fiber board may also be incorporated.

The first dressing subsequent to the operation should be at the end of not more than 24 hours. The fear of disturbing or loosening the grafts probably has deterred surgeons from exposing the wound at this time. Gentleness must necessarily be observed in removing the strips of tissue, although no unusual skill is required. The strips are removed either individually or collectively. Here and there adhesions may be present, which necessitate counter pressure on the graft as the strips are lifted. At this first dressing the grafts appear dead white since there is as yet little or no circulating blood in them. The test of capillary circulation is not present. At this time the graft is being held by the matrix of fibrin and is being nourished by a plasmatic lymph circulation. Endothelial cells of the capillary tufts of the granulation tissue are budding out to form anastomoses with the vessels of the graft, but definite vascularization has not yet been established. The wound exudate present on the dressings is considerable and smears of the exudate from wounds covered by granulation surfaces show organisms as a rule. The surface of the grafted area may be lightly sponged

with tufts of Grade A absorbent cotton wrung out in boric solution and fresh strips of cellosilk and gauze rolls applied as at the primary dressing.

At the end of 48 hours the grafts show a decided change in appearance. They now present a pinkish hue and respond to the test of capillary circulation. J. Staige Davis and Herbert F. Traut in a series of experiments with dogs have observed vascularity as early as 22 hours in whole thickness grafts. These primary anastomoses are usually complete in 48 to 72 hours. We may therefore state as a fact that union has occurred, that the graft has actually "taken" when the test of capillary circulation is positive. Clinically this will be found to correspond exactly with the findings in Davis's and Traut's experimental animals. Their statement is as follows:

"We conclude that there are two stages in the process of actual vascularization of the graft. These have been preceded by what has been called the stage of plasmatic circulation, which probably bears an important rôle in the survival of the whole thickness of the graft. The first stage of vascularization is supplied by those vessels which form early anastomoses with small vessels of approximately the same caliber in graft and host. The earliest that this was noted was about 22 hours after transplantation, and this continued to occur up to about 72 hours. The second stage and the most important one, as it establishes a more voluminous blood supply which eventually forms the permanent vessels of the graft, begins on the fourth or fifth day and has completely penetrated the graft by the twelfth day. At this time, the various elements of the graft are actively regenerating, especially is this true of the connective tissue of the corium, which is richly supplied with new blood vessels."

At the succeeding daily dressings it may be noted that here and there a bleb may form, partially raising the graft from its bed. These blebs should be punctured, thereby saving many grafts which would be sacrificed were the initial dressing postponed for the customary period of 5 to 8 days.

As early as the fourth and fifth days, dressings may be discontinued and the area exposed. During the first day of exposure the grafts should be watched carefully as the vents for the escape of wound exudate may close off too rapidly and blebs form which would tend to detach the grafts here and there. Puncturing the blebs may be practiced, or application of moist dressings may be resumed and continued until the period of degenerative and inflammatory changes has terminated. These degenerative changes, together

with a varying degree of inflammation due to the reaction of the tissues to the presence of micro-organisms account for the continuance of wound exudate during this period (4)

*One may expect the average case to be entirely epidermatized in 7 to 10 days under this method of postoperative care*

The objection frequently raised to the use of Ollier Thiersch grafts on areas where shrinkage would be an untoward factor may be met in some degree by urging the profession to bring areas requiring grafts to the prime condition rapidly and to transplant before the fibroblasts are consolidating into scar tissue. Following the detachment of the sloughing tissues of third degree burns or extensive wounds a wet dressing of 1/2 per cent zinc sulphate solution in most instances will promptly transform the surface to one of fine coral red granulations. The high degree of vascularity of the granulations will be attested by the ease with which bleeding occurs when they are sponged with gauze. If grafting be done promptly the degree of shrinkage that follows will be greatly diminished.

*No reference has been made to the technique of cutting and placing Ollier Thiersch grafts as the*

details of transplantation are so well standardized that they may be omitted

#### SUMMARY

Daily dressings of Ollier Thiersch skin grafts are advisable inasmuch as the wound in most instances is an exudative contaminated one which may readily pass to a state of infection with consequent sacrifice of transplants. Scrupulous surgical cleanliness with early and frequent removal of wound exudate alone may be expected to give uniformly excellent results. A rational method of procedure is described which tends to maintain grafts in position. The method is in accord with the sequence of histological changes and results in earlier complete epithelization.

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# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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Chief of Editorial Staff

NOVEMBER, 1927

### NURSE VERSUS DOCTOR

THE standing of the medical profession has been won by many years of strenuous endeavor. The actuality and scientific basis of our achievements distinguish us from the various cults, and our knowledge and experience place us upon a higher level than the trained nurse, however admirable in her own field a nurse may be.

It goes without saying that this hard won prestige should be guarded with jealous care not only for ourselves but for those who are to follow us. In order to accomplish this it manifestly is our duty to see that the dignity and authority of the younger members of our profession are encouraged and guarded as far as lies within our power, especially in the institutions over which we have jurisdiction. And yet, in spite of this obligation, there is a growing tendency in some hospitals, fortunately not in all, to exalt the nurse at the expense of the interne.

Some staff officers, for instance, seem inclined to deal directly with the nurse in the handling of their cases, rather than with the interne, thus depriving the latter of that responsibility and authority which is so

necessary to his professional development. I even know of a hospital in which this degradation of the internes was carried so far that their authority was practically annulled, a situation which, properly enough, led to such a taboo of the institution by younger physicians that internes could not be obtained.

In some instances as I have seen this recent tendency toward the aggrandizement of nursing seemingly has led to the assumption of an unwarranted independence of this department from the medical organization of the hospital, in spite of the fact that nursing, however important it may be, is nevertheless subordinate to treatment, and always should be carried on under the supervision of the medical staff, which should be consulted upon all important matters.

One of the worst offenses along this line has appeared in the establishment in certain hospitals of so called "treatment centers," where surgical and other supplies are concentrated in the charge of graduate nurses and dealt out to the various rooms and wards as required. This perhaps is not a bad idea when confined to its legitimate function, the furnishing of supplies, but unfortunately in some instances it has gone far beyond this, and to the nurses of these centers has been delegated the changing of dressings, the giving of hypodermoclysis, and many other duties which properly belong to the internes, or, under their directions, to the floor nurses. This not only comes dangerously near to making doctors out of nurses, but it deprives the house physicians and floor nurses of their rightful prerogatives, and gets them out of that close touch with their patients which is so necessary to their

proper instruction and to the intelligent handling of their cases. In other words it leads all along the line to a wholesale passing of the buck back to the treatment center, and everyone loses out accordingly. After all, there is something in a name and the situation would perhaps be remedied by changing the term 'treatment center' to "supply center" which indicates more accurately what it really should be.

The trained nurse is an indispensable asset deserving of our greatest respect and appreciation but it should be understood that after all she is a nurse and not a doctor. Her subordinate position in this respect should be clearly defined and any tendency which may quite naturally develop to cross the boundary should promptly and courteously be discouraged in her own interest as well as that of the medical profession and the patient.

LEONARD FREEMAN

## DIRECT MICROSCOPIC EXAMINATION OF FISTULE

ONE of the disappointing results of surgical operations is the formation of a draining sinus or fistula. Although it is true that in certain operations this is a desirable result in the majority of cases it is an indication of unsatisfactory surgical procedure or the presence of some disease that does not permit the healing of tissues. The diagnosis of such a pathological condition is often difficult due to the fact that cultures made from these sinuses are usually a waste of time since so many secondary organisms are present that the original causative organism is masked. It is in such cases that direct microscopic examination of scrapings from the tract is of greatest importance.

The inclusion of a foreign body may often be determined by lightly curetting the tract

with a wire curette. The curette consists of a piece of 22 gauge microne wire rounded into a loop 3 millimeters in diameter, the other end of the wire is inserted into a suitable handle. The flexibility of the wire prevents injury and accidents. Occasionally parts of a sponge may be withdrawn through the tract or hard objects such as bone sequestra or surgical instruments may be encountered. On one occasion a large mass of hardened bismuth paste was detected over the region of the kidney and its removal by surgical intervention resulted in the healing of a sinus tract of about 3 years duration following nephrectomy.

Even teratomata have been diagnosed by this method. By the removal of long tufts of hair by the curette through a sinus tract in the sacral region teratoma was accurately diagnosed in the case of a middle aged man.

The diagnosis of tuberculous tracts and tuberculous ulcers by the direct microscopic method is of extreme value. Records in the Mayo Clinic have disclosed the fact that many tuberculous sinuses in the chest and abdomen have been diagnosed in this manner.

Also sinuses in the scrotum various joints, and in the neck resulting from the breaking down of tuberculous lymph nodes have been diagnosed tuberculous. Tuberculous lesions in the ear larynx and pharynx have been accurately diagnosed by this method. Two cases of tuberculous peritonitis have been diagnosed from scrapings of sinus tracts draining from the umbilicus and one case of tuberculosis of the breast was diagnosed from scrapings taken from a sinus draining from the left breast. The tuberculous sinus tract is characterized by rather prominent pouting lips the area about the sinus is dusky purple and the patient usually shows loss of weight as contrasted with the patient having actinomycotic sinuses when the weight is

usually normal or increased. The sinus should be curetted until bleeding occurs, this is easy in tuberculous tracts since they are vascular as contrasted with sinuses due to actinomycetes.

The diagnosis of actinomycosis (*actinomyces hominis*) is practically dependent on the finding of sulphur bodies in the drainage material. About 200 cases have been so diagnosed in the Mayo Clinic. These represent lesions of the head, neck, abdomen, and chest. The lesion is fairly characteristic. The sinuses are often multiple and the history usually extends over several months or even years. As a rule there is little granulation tissue around the mouths of the sinus and discoloration is not a prominent characteristic. Such sinuses usually appear as simple holes in the flesh, and if a scab is present it is very thin and bloody. The tract does not bleed much when it is curetted and the typical sulphur bodies usually come out on the loop of the curette. The drainage material is usually thin. Often the sulphur bodies are obtained from a deep part of the sinus when none are evident in the draining pus. The abdominal sinuses are in and around the appendiceal region and the patient's history is rather stereotyped. He was operated on for acute appendicitis several months or even years

before. At the time of the operation drains were probably inserted because the appendix had ruptured, the wound had not healed, or if it had, it had broken down periodically. On examination one or more sinuses are found and often these have penetrated through the body, and sinuses are found in the sacral region. A definite clue is furnished by the fact that, with the marked development of sinuses, bone is rarely if ever involved, thereby differing from tuberculosis.

The diagnosis of other mycotic lesions and sinus tracts developing from the involvement of bone due to typhoid bacilli is an exception to the rule that the diagnosis must be made on direct microscopic examination. In these cases cultures are necessary and by suitable cultures the presence of acid fast actinomycetes, which have in the past been called nocardia, or streptothrix and typhoid bacilli is detected. Occasionally cancer cells are found in the scrapings from sinuses. The nasal scrapings are of tremendous importance in the diagnosis of leprosy.

A plea is made for more careful direct microscopic examination of chronic draining sinuses and fistulas, such examination will amply repay the diagnostician for his efforts.

T. B. MAGATH

# MASTER SURGEONS OF AMERICA

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## SAMUEL JASON MIXTER

THE passing years add to the list of the illustrious dead. We who are living pay homage to the great men of the past who made meritorious contributions to the progress of the world and who to the last carried on by example or precept in order to leave undone nothing that might help the causes they so nobly espoused. To such Samuel J. Mixter belonged.

It is nearly thirty years since I first went to Boston to visit clinics and to learn from the Fellows of the splendid Boston school of surgery, always sane, sound and solid, free from illusions or extreme views in verity, the truth tellers. As I went into the reception room of the old Massachusetts General Hospital to learn what would be presented at that day's clinics, there came with buoyant step and pleasant smile Samuel J. Mixter. He recognized at once that I was a diffident young man from the West and kindly asked what he could do. He took me under his wing, introduced me to the staff of the hospital and into the various operating rooms and made me feel at home. In the many years that have passed since that day I have never failed to appreciate his warm interest, not only in surgery but in the surgeon as an individual as well.

This personal tribute to Dr. Mixter I make as an introduction to the memorial written by two of his colleagues and adopted by the Boston Surgical Society.

W. J. MAIO

Samuel Jason Mixter was born in Hardwick, Massachusetts, on the tenth of May, 1855. His father William Mixter, and his mother Mary Ruggles Mixter were both of old New England stock. He died after a brief illness of pneumonia at Grand Junction, Tennessee, on January 19, 1906.

His boyhood was chiefly spent at Hardwick and at school in Amherst, Massachusetts. He entered the Massachusetts Institute of Technology, where his natural tastes led him to specialize in physics and later, after graduation, to undertake the study of medicine, a course in which he received little parental encouragement. He graduated from the Harvard Medical School in 1879, completing his course as West Surgical House Officer at the Massachusetts General Hospital in the same year. In 1879, as well on August 12, came the fortunate event of his life, his marriage to Wilhelmina Galloupe.



SAMUEL J MIXTER  
1855-1926





This was followed by a year in Vienna, where his interest was keenly stimulated in anatomical studies and by the developing microscopic pathology. On his return to Boston, his work in microscopy and anatomy was continued. In 1882 he became assistant demonstrator and in 1887 demonstrator of anatomy at the Harvard Medical School. His enthusiasm was infectious to students and drove him to continuous activity, to the painstaking care and thoroughness of which his beautiful corrosion specimens in the Warren Museum still bear witness. His teaching later swung to operative surgery, a field which gave further scope to his great mechanical ingenuity.

Thus, from the first, his tastes and training led him to surgery where his ability and special aptitude resulted in rapid progress. Appointed to the Surgical Service of the Carney Hospital in 1880, and Surgeon to the Out Patient Department of the Massachusetts General Hospital in 1886, he became successively surgeon to the Carney Hospital, resigning in 1897, visiting surgeon to the Massachusetts General Hospital in 1893, chief of the West Surgical Service in 1911, resigning at the age of sixty-four in 1919.

From his background and the character of his training, some inklings as to the nature of his surgery may be derived. Brought up on a sound anatomical foundation before the era of specialization, in the beginning of antiseptics, when the shadow of infection threatened, his training had a breadth and a respect for surgical dangers now vanishing. To this he added great mechanical ingenuity and a keen, conservative judgment. His operating was marked by simplicity and directness, qualities which can only come from thorough anatomical knowledge, great skill, and a keen appreciation of essentials. His sense of mechanical fitness made him dislike cumbersome instruments and technique. Intellectual honesty caused him to be impatient of shams and pretenses, and of an unbalanced interest in percentage figures of operative mortality. Sound judgment, sure and rapid operating, complete lack of mercenary traits, entire self forgetfulness in the interest of his patients, were qualities which begat confidence in the minds of practitioners and laity alike.

In surgery his resourcefulness and ability to cope with the difficult and unusual attracted him to neglected fields. From this came his contribution to the surgery of the œsophagus and of the central nervous system, advances which stand out among others he added to the rapidly developing science of surgery. His contributions to operative technique, unfortunately, will be known chiefly by tradition, in the fertility of his invention they seemed to him hardly worthy of record. It is only natural and fitting, therefore, that he should have been chosen president of the American Surgical Association in 1917, and that the New England Surgical Society should have turned to him for its first president.

Success in a profession is in itself an accomplishment which the world stands ready to honor. Dr. Samuel Jason Mixter's eminence in surgery needs no com-

ment or support, it is a fact grown so familiar that we can as yet be scarcely conscious of the gap left by his death. But although accomplishment in surgery should be duly honored, it is not for that reason alone that we delight in the memory of Dr. Mixer. We are led rather to think of the personality and character that lay behind it. To his numerous friends he seemed the personification of kindly hospitality, so open hearted and genuine that it spread an irresistible warmth. It is pleasant to remember the true cordiality with which he was received at meetings of the American Surgical and Southern Surgical Associations. Some of us may think of the generous sportsman, forgetful of his own sport in the interest of sharing it with others, or of mornings during fishing trips spent actually holding impromptu clinics for the families of guides and natives, to be followed by minor operating on teeth and tonsils. Generosity, loyalty, affection and interest in others stood out in all his dealings. These same qualities shone most clearly during the War, and his sentiments of patriotism and of indignation against wrong were strikingly expressed in his presidential address before the American Surgical Association. One of the first men to join the Medical Reserve Corps at the time of its organization, he hastened to undertake active duty.

Through all this active and useful life there runs the support of an harmonious family relationship. In later years after retirement from active practice it was natural that his interest should have turned increasingly to the scenes of his childhood in Hardwick, to his magnificent herd of Guernsey cattle there, and to the outdoor sports he so much loved. It seemed a fitting and peaceful conclusion to a full life. But the death of Mrs. Mixer left a void which his cheerfulness could not conceal.

To have contributed actively to surgery, to have held rightly the confidence of patient and of physician, to have stimulated warm friendship, to have served his country well, and to leave worthy successors, is it not enough?

G. W. W. BREWSTER

E. P. RICHARDSON



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# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

BY ALFRED BROWN, M.D., F.A.C.S. OMAHA

### THE COURSE IN OPERATIVE SURGERY BY PIERRE DIONIS

WITH the passing of the French surgeons of the latter part of the sixteenth and early part of these seventeenth centuries, particularly Pare, Jacques Guillemeau and Franco surgery in France retrograded as it did in great measure in other countries. Men like Galileo, Sir Isaac Newton, Rene Descartes, Pascal and Francis Bacon held the center of the scientific stage and offered such competition that surgery was not able, with the materials then at its command to obtain much public attention. In medical science Borelli and the great William Harvey gave their attention to internal medicine and brought forward that side of the medical art so prominently that their followers in France saw their opportunity and promptly took advantage of it. The medical faculty won a victory over the surgeons and obtained a royal decree which united the barbers and surgeons in one corporation. In consequence, the College de St. Côme which had worked constantly for the better education of surgeons lost much of its power. All of these factors made for the temporary innocuous desuetude into which seventeenth century surgery passed.

In the middle of the seventeenth century Pierre Dionis was born and by its third quarter was well on the way toward bringing surgery back into prominence for he began to teach in 1673. In the introduction of his book he says: "The King better informed than any in his Dominions of whatever can contribute to the good of his subjects by a particular Declaration which he caused to be verified and registered in his Presence in March, 1673, ordered that the Demonstrations of Anatomy and Chirurgical Operations should be annually held in his Royal Garden gratis and with the doors open in order to furnish young students in Chirurgery with the means of perfecting themselves in their art, which his Majesty has always looked on as one of the most necessary in a State. This declaration proved to be of immense importance to surgery, for it marked the beginning of true surgical teaching in France and the starting point of the great French school of surgeons who led the surgery of the world for more than a century. Dionis thus had his permission to teach and began to demonstrate anatomy at the Jardin du Roy. At approximately the same time other public demonstrations were begun at the

Medicinal School and at the College de St. Côme. All of these demonstrations were performed by sworn master surgeons the others, presumably being Georges Marechal surgeon of the Charite and first surgeon of Louis XIV, and Jean Mery, first surgeon of the Hôtel Dieu.

Dionis held that the most important subject for a surgeon to have in hand was anatomy. Consequently, the first course was anatomical demonstration on the cadaver. This a student had to take before he could begin surgery. Dionis published his Anatomy *L'Anatomie de l'homme* in 1690 at Paris, seventeen years before his *Course of Operations*. It immediately became one of the most popular medical books of the time and was translated into many other languages even into Chinese.

The surgical course became so popular that the original provisions of the Declaration had to be changed and the course limited for he says: "For the space of eight years I have performed those in the Royal Garden to which the Concourse of Students was so great, that the largest Hall destined for them would not hold one half of the Auditors which obliged us to prepare Sealed Tickets which we distributed to Chirurgeons Apprentices that they alone might enter and to avoid confusion by the exclusion of those who were plac'd to serve their time in Barbers Shops and of those whose bare Curiosity drew them thither."

If Dionis teaching ability was equal to his interest as a writer, this statement is not overdrawn for his *Cours d'operations de Chirurgie*, first published at Paris in 1707, is a delightful book even in the English translation of 1710, illustrated here in which some of the charm of the original is of necessity lost as in all translations. Dionis does not confine himself entirely to surgery for he indulges also in anecdote and history. He tells more clearly than any other author, the story of the great Frere Jacques a contemporary traveling surgeon of no education, but a man who commanded a very large clientele. The operations themselves are described in a systematic manner an illustration of the instruments and apparatus used is followed by a minute description of the operative technique and in some cases, that of hernia for example, there is a preliminary discussion of the various types of operation performed up to the author's time which is most valuable for the student of the various surgical procedures.

## REVIEWS OF NEW BOOKS

A SMALL monograph<sup>1</sup> dealing with modern operative measures for the cure of inguinal hernia and related features of the anatomy and physiology of the abdominal walls has recently been published. In the introduction by Sir Arthur Keith his well known views on the shutter like action of the muscles and tendons of the inguinal region are stated.

In the operation which is described use is made both of the principles of a purely fascial closure and of autoplasmic suture material. Cowell's operation is an ingenious attempt to make use of the principles expounded by Keith and to provide a wall to the inguinal region which will contract when the other abdominal muscles are under tension. Much stress is laid on the grip or squeezing of the finger inserted into the inguinal canal when the subject strains. This is said to be well marked in normal individuals and absent in sufferers from hernia and the operation is said to restore this grip.

In order to insure its complete removal the sac is dissected unusually high into the abdomen and cut off and the edges closed with a running suture. The closure he advocates consists in freeing a strip a half inch wide from the external oblique aponeurosis and sewing it into the floor of the inguinal canal under the cord. The lower edge of this pedicled flap is sutured to Poupart's ligament and the upper edge to whatever tendinous or fascial structures lie convenient along the inner border of the conjoined tendon. It is evidently hoped that this strip will be pulled tightly against the internal ring when the abdominal muscles contract in response to intra abdominal tension.

Unfortunately photographs are used to illustrate the operation which are so poor that nothing can be learned from them. The remainder of the 72 illustrations are also of very low grade.

While time alone can decide the value of Cowell's operation it looks like a promising step in advance and the book is of great value in being a good review of the newest work on hernia and helping to call attention to the wretchedness of our operative results. It should bring to the attention of surgeons the fact that the last word has not been said on hernia.

EDMUND ANDREWS

DILLER<sup>2</sup> rightly says in his preface that the history of medicine in Western Pennsylvania is closely bound up with the history of the country. In the early days there was an intimate relationship between medical and military life. The first surgeon soldier in Diller's fascinating narrative is Dr James

Crail who accompanied General Braddock on his disastrous expedition to the Pittsburgh region in 1754 and who later became Washington's private physician. Then came Hugh Mercer medical graduate from Aberdeen long a pioneer doctor in the then wilderness of Pennsylvania who became a brigadier general in the American army during the revolutionary war and died of wounds sustained at the battle of Princeton. Among other interesting medicomilitary characters of those days were John Connolly, Edward Hand and William Irvine. Another interesting group was made up of preacher physicians typified by Joseph Doddridge who fortunately left a book of notes to posterity. However the first place of distinction in the medical annals of Pittsburgh is accorded to surgeon Albert C. Walter born and educated in Germany and Diller's fine chapter on this man should particularly interest surgical readers. Aside from its medical interest this book gives a vivid picture of a picturesque period of American frontier history. The style is the best as are paper print and illustrations.

PETER BASSOE

J. RICHARD WHITE<sup>3</sup> presents a textbook of surgical handicraft for medical students. In the opening chapters on aseptics and antiseptics are brief but interesting biographical sketches on Semmelweis, Pasteur, Lister, Holmes and others identified with this period. The chapters on antiseptics and surgical material cover completely the action use and formula of various antiseptics as well as the preparation of suture materials and operating room sterilization. Subsequent chapters are devoted to bandaging adhesive plaster strapping and the technique of knots ligatures and special sutures.

The last portion of the book is devoted to pre operative preparation principles of operative technique postoperative treatment the control of hemorrhage and various minor surgical procedures.

The text offers to the student and interne many important practical details of handicraft which through lack of time he cannot adequately get in our present medical curriculum. J. R. BUCHHEIMER

WHILE much has been written of tropical medicine Major Chatterji's valuable book<sup>4</sup> is probably the only work of any consequence devoted to tropical surgery. The author's more than 25 years experience in Calcutta and other places in India has well fitted him for the authorship of a work

A TEXTBOOK OF SURGICAL HANDICRAFT FOR THE USE OF MEDICAL STUDENTS, 3d ed. By J. R. White, M.D., Ch.M. (N.Y.) F.R.C.S. (Eng.) F.A.C.S. New York: The Macmillan Company, 1919.

TROPICAL SURGERY AND SURGICAL PRACTICE. By KARUN Y. CHATTERJI, F.R.C.S. (Maj.) I.T.F. Medical Corps, W. India. Foreword by Major-General Sir R. H. Velock, Charles G. V.O., F.R.C.S. (M.D.), LL.D. New York: F.R.C.S. (M.D.) (Ret.), New York: Williams & Co. Company, 1917.

<sup>1</sup>HERNIA AND HERNIOPLASTY. By Ernest M. Cowell, D.S.O., M.D., B.S. (La.) F.R.C.S. (Eng.). With an Introduction by Sir Arthur Keith, F.R.C.S. F.R.S. New York: Paul B. Hoeber, 1917.

<sup>2</sup>PIONEER MEDICINE IN WESTERN PENNSYLVANIA. By Theodor Diller, M.D. With a foreword by J. J. Buchanan, M.D. New York: Paul B. Hoeber, 1917.

which is not only indispensable to those who are about to practice tropical surgery and who are unfamiliar with it, but also has great interest and profit to surgeons in non tropical countries. The writer discusses the peculiarities of tropical surgery as distinguished from that of colder climates the subject of amebiasis with all phases of hepatic amebiasis, and filariasis and the numerous surgical complications arising from this infection. The details of the surgical treatment of elephantiasis of the scrotum are carefully taken up.

The section on tropical granulomata describes the pathology, diagnosis, and treatment of some 23 varieties. Other sections take up schistosomiasis, ascariasis, and bone and joint surgery including psoasitis and anihum. The section on abdominal surgery is brief. Interesting chapters on snake bite and injection of saline solution in cholera are included. The book is a valuable contribution to surgical literature.

FREDERICK CHRISTOPHER

THE second edition of Kneise's *Atlas of Cystoscopy*<sup>1</sup> is a much larger work than was the original edition. The many new illustrations adding value and increasing its worth as an adjunct to the better understanding of cystoscopy. On account of the number and variety of illustrations the author rightly does not deem it necessary to discuss the development of cystoscopy or give details as to instrumental aseptis technique of endovesical operations, kidney function tests etc. In any atlas these discussions are matters of less importance than the illustrations and in the case of the atlas under discussion by reason of its many illuminating illustrations discussions wandering off into details would surely detract from its worth and value as an atlas in the best sense of the term.

The arrangement of the book is exceedingly satisfactory. It consists of three parts: a brief introduction to the subject, the atlas proper represented by a section of 102 colored illustrations and a series of clinical histories.

The colored illustrations begin with plates showing the normal bladder and variations in the normal bladder and urethral openings followed by inflammatory changes seen in the common and rare forms of cystitis. The various cystoscopic changes associated with benign hypertrophy of the prostate are given careful consideration. With unusual truthfulness are illustrated a series of bladders the various types of stones, different types of foreign bodies in the bladder, benign and malignant tumors and the various intravesical methods of treatment such as the cystoscopic snare and fulguration. Bladder fistulae, diverticula and ureteroceles are illustrated in a manner that leaves nothing to be desired and again truth is not maimed in the making of artistic illustrations.

The section of the atlas devoted to clinical histories will be found of great help to the reader, if for no other reason than that by means of these

histories a better understanding of the illustrations is achieved.

All in all this atlas is one that should be highly commended. It has been prepared with care and in no instance has the scientific spirit been sacrificed.

HERMAN L. KRETSCHMER

IN his monograph<sup>2</sup> on prostatic surgery, Dr Walker brings up to date the knowledge upon this subject. It might well be read by specialists. In contrast to many European compilations the work follows the generally accepted ideas of American urologists the author having familiarized himself thoroughly with recent advances in this subject both in America and abroad. The subject matter is presented in a simple easy reading fashion with the greatest stress laid upon practical considerations. The anatomy and physiology of the prostate and contiguous structures and the pathology of enlargement constitute the preliminary chapters. Symptoms, diagnosis and treatment with emphasis as to the importance of pre-operative and postoperative treatment are given in detail.

VINCENT J. O'CONNOR

A COMPREHENSIVE monograph<sup>3</sup> by Foerster on the sensory pathways for pain and the surgical treatment of painful conditions illustrates very well one of the statements the author makes in the introduction, that although neurology has given much to surgery, surgery has caused neurology to revise many dogmatic theories. The monograph is divided into two parts.

The first deals with the physiology of the sensation of pain. In this section the author presents in a clear and comprehensive manner the recent thoughts concerning pain. The isolated supply of peripheral nerves is described stressing the areas of overlap. Visceral sensibility is then reviewed. There follows an important description of personal observations upon root distribution of sensory fibers. The failure of posterior root section to relieve painful states has given rise to experimental work upon the possibility of pathways other than the posterior roots and the author describes the conception of an antidromic fiber in the anterior root which he, with others described in 1920 after the work of Leonard Kidd. The question of the possible sensory function of the sympathetic system and an extraradicular pathway is discussed. Of great importance are the numerous observations permitting a description of the lamellar distribution of sensory fibers within the spinal cord and brain stem. Thalamic pain and cortical sensory localization is described.

The second part covers affections of the peripheral nerves and their treatment including neurolysis, nerve block, root section, periarthral sympathectomy, amputation neuromata, cervical ribs, neuritis,

<sup>1</sup>THE ENLARGED PROSTATE. By Kenneth M. Walker. F.R.C.S. M.A. M.B. B.C. New York: Oxford University Press 1936.

<sup>2</sup>DIE LEITUNGSBAHNEEN DES SCHMERZGEFUEHLS UND DIE CHIRURGISCHE BEHANDLUNG DER SCHMERZKRAENDE. By Prof. Dr. O. Foerster. Berlin: Urban & Schwarzenberg 1927.

<sup>3</sup>HANDATLAS DER CYSTOSCOPIE. By Dr. med. Otto Kneise. Leipzig: Georg Thieme 1936.



and neuralgia affections of the cranial nerves with the glossopharyngeal vagus and intermedius neuralgias visceral nerve surgery angina pectoris intermittent claudication and thrombo angitis obliterans and diseases of the spinal ganglion and roots cord tumors tabes dorsalis and other diseases of the cord and brain stem. Finally a description of an interesting group of headaches in given which revives the embalmed conception of disproportion between the size of the brain and the cranial cavity

LEWIS J POLLOCK

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The chapter upon surface markings of muscles is excellent. That upon electrical examination is limited to older methods. In the discussion of reflexes much space is devoted to a description of reflexes which are little disturbed in peripheral nerve lesions. Considerable attention is paid to physiotherapy but the various surgical procedures in the repair of injuries are only briefly mentioned.

In the consideration of injuries and disease of special nerves the description of the anatomy and physiology is comprehensive and clear. The liberal quotation of the opinions of other authors makes the material profitable and interesting.

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DE RE IPSE SCREEN LERUNGEN DIAGNOSTIK UND THERAPIE VON VERLETZUNGEN UND ERKRANKUNGEN DER NERVEN UND MUSKELN. By Dr. F. D. Tolby. Ch. B. Urban & Schwarzenberg 1927.

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**THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR Vol. II Administration American Expeditionary Forces** Prepared under the Direction of Maj. Gen. M. W. Ireland by Colonel Joseph H. Ford M.C. Washington: United States Government Printing Office 1927.

**THE DECLINE IN LEAD POISONING** By Frederick L. Hoffman LL.D. (Address Delivered Before the Health Congress of the Royal Institute of Public Health Ghent Belgium June 1-6 1927.)

**INDUSTRIAL INSURANCE** By Frederick L. Hoffman LL.D. (Address delivered before the Eighth International Congress of Actuaries London England June 25-30 1927) Prudential Press 1927.

**SAN FRANCISCO CANCER SURVEY FOURTH PRELIMINARY REPORT (Seventh and Eighth Quarterly Report)** By Frederick L. Hoffman LL.D. Conducted under the auspices of the John Hancock Mutual Life Insurance Company The Pacific Mutual Life Insurance Company and The Prudential Insurance Company of America Prudential Press 1927.

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# SURGERY, GYNECOLOGY AND OBSTETRICS

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## PARASTERNAL INVASION OF THE THORAX IN BREAST CANCER AND ITS SUPPRESSION BY THE USE OF RADIUM TUBES AS AN OPERATIVE PRECAUTION<sup>1</sup>

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THE key to further advances in the operative treatment of malignant disease is not to be found in statistical studies in which large numbers of cases are superficially studied often at second hand in the light of existing knowledge. It is in the ward and laboratory rather than in the bureau of health statistics that the information we require is to be sought.

The present paper aims at showing that in many cases of breast cancer, early invasion of the lymphatic glands lying along the internal mammary arteries takes place at a date prior to operation.

The growth of these microscopic colonies, sometimes after many years of quiescence, falsifies the hope of cure. Nodules of growth at the inner end of the upper intercostal spaces, or a lump in the sternum ultimately make manifest the latent process. I shall endeavor to show that by an intelligent appreciation of this danger and by the use of proper means to deal with it in its earliest stage a further improvement in operative results can be attained.

In 1911, Halstead in a masterly paper showed that in breast cancer, if the disease is attacked before the axillary glands are involved, 2 cases out of 3 can be cured, while if the axillary glands are demonstrably cancer-

ous 3 out of 4 patients ultimately succumb to the disease.

During the 4 years (1920-1923) I operated upon 77 cases of breast cancer at the Middlesex Hospital. Only 20 of these cases were free from axillary involvement, and of these 20 16 remain well from 3 to 6 years later, 1 died of pneumonia 3 years later, 1 died 2 years after operation of an unknown cause, 1 died as the result of the operation, and one cannot be traced. Thus in the early stage of the disease operation is successful in 85 per cent of cases. On the other hand, of 24 cases in which the disease though still operable had involved the axillary glands, only 3 are alive and well at present 3 to 6 years later. The remaining 20 cases were frankly palliative operations for very advanced growths. Forty five per cent of all the operable cases, or 47 per cent if the case of death from pneumonia is counted as a non-recurrence, remain successes from 3 to 6 years later.

The results in the early cases show a definite improvement on Halstead's, the ratio of successes having gone up from 2 of 3 to 4 of 5. To what is this improvement due? It may be reasonably attributed to the fact that during the last 6 years I have inserted radium tubes as a prophylactic in nearly every primary breast operation. My standard procedure is

<sup>1</sup> Read before the Clinical Congress of the American College of Surgeons, Montreal, 1926.

to insert four 25 milligram tubes screened by 1 millimeter of platinum in the following positions one tube at each place for 24 hours (Fig 1)

1 Above the first rib internal to the subclavian vein in the position of the terminal portion of the main lymphatic duct whether right or left This tube lies close to the gland at the lower and inner angle of the posterior triangle the gland in which supraclavicular recurrence first shows itself

2 At the inner end of the first intercostal space buried in the intercostal muscles

3 At the inner end of the second intercostal space

4 At the inner end of the third space

Tubes 2 3 and 4 it will be seen follow the course of the lymphatic trunk which accompanies the internal mammary artery and lie close to the glands which are contiguous to this artery (Fig 2)

The placing of these tubes is based upon a close study of the recurrences which took place in a previous series of cases in which the same operation and the same X ray course was employed but no radium was used

Local and axillary recurrence were almost absent from the series These forms of recurrence have been almost abolished by the improved technique of the modern operation which takes account of the centrifugal spread of the disease by permeation of the lymphatic plexus of the deep fascia It is a great satisfaction to me that the permeation theory of dissemination obtained the support of Professor Halstead's authority and that in order to meet the pathological requirements he altered his operative method and began to practice extensive undermining of the skin flaps a step which he had not previously considered necessary

Although the modern operation suppresses local recurrence and so keeps the patient active and happy until near the end it generally fails in the long run to cure the disease if the axillary glands are already affected

The enlargement of the axillary glands I believe is not in itself the lethal factor for recurrence in the axilla after an efficient operation is very rare It is however an index to another and more subtle mode of invasion, to

which I desire to direct your particular attention I believe that by the time the axillary glands are enlarged the disease has frequently and perhaps usually obtained access through the inner ends of the intercostal spaces to the internal mammary gland and that in quite early and still operable cases these glands contain microscopic deposits of cancer cells

What is the evidence for this belief? It is the fact that in more than half my recurrent cases before I began the prophylactic use of radium the return of the disease manifested itself either by an enlargement of the gland at the lower and inner angle of the posterior triangle or by the appearance of nodules later merging in eternal recurrence upon the deep fascia at the inner end of the first, second or third intercostal spaces The position of these recurrences accurately along the line of the internal mammary artery shows I think beyond doubt that they are due to invasion of the lymphatic glands which lie along its course

To excise these glands is possible, I have done it in 5 cases but it makes the operation too long and severe On the contrary to bury radium in them or close to them, is quite easy and does not prolong the operation more than 5 minutes The procedure does not increase the risk of the operation In 2 or 3 cases it has led to a small pneumothorax, but only one of these cases gave rise to anxiety, and the patient recovered Care must be taken to keep the tubes at least half an inch beneath the skin and if a thin skin flap lies directly over one of the tubes that tube should be left in position for a shorter time—say 12 hours only

I have obtained definite evidence, which I will later produce that radium tubes used in this way can destroy microscopic and even massive deposits in the internal mammary glands But it is clear that the use of them is not likely to produce any startling improvement in results They must be used if at all in a routine fashion in every case for we have no means of telling in a given case whether the glands are or are not affected In this regard operable cases of breast cancer are divisible into three groups not clinically distinguishable one from the other



Fig 1 Showing the portion of the buried radium tubes along the line of the internal mammary glands and the lowest supraclavicular glands

1 Cases in which the internal mammary glands are not infected at the time of the operation

2 Cases in which these glands are so infected

3 Cases in which the glands are infected and in addition the disease has already spread beyond them to other glands within the thorax

As regards the use of radium tubes in the way I suggest, it is clear that it will produce no improvement of results in Groups 1 and 3. In the first group it is superfluous, in the third necessarily ineffective. The action of radium is local only and cases in Group 3 will run their course unchecked by operation, radiation, or any other means at present known. But in Group 2, I believe that the use of radium will make the difference between failure and success. I have had the opportunity of watching for 12 years a case which clearly, at the time of operation, belonged to Group 2.

Five years after I had operated for a carcinoma of the left breast a little nodule appeared at the inner end of the second left intercostal space. Nearly 2 years later a similar nodule appeared at the inner end of the third space, and 2 years still later one at the inner end of the fourth space. Four months afterward, the fifth space was invaded and shortly after that the sixth. The disease then spread outward along the fourth and fifth spaces, and finally the opposite breast and pleura were attacked, the patient dying 12 years after operation. The slow descending infection of the internal mammary lymphatic chain is here unmistakable. It seems certain that the gland in the second space was the only focus of disease within the thorax at the time of operation and that if radium tubes

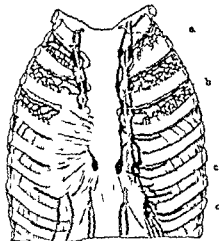


Fig 2 The internal mammary glands a different vessel of the internal mammary chain b c glands of this group d diaphragmatic gland (reproduced from Fournier's *The Lymphatics* translated by Leaf Constable 1903)

had been used at that time the disease would have been permanently cured.

This case is so instructive and it is so difficult to get precise records of clinical history over so long a period as 12 years, that I have thought it worthy of illustration and of detailed record. Incidentally it illustrates perfectly the slow centrifugal spread of the disease along the lymphatic vessels. It also shows that modern methods of treatment, even when they fail to cure, maintain the patient's activity and comfort over a long period of years.

MODE OF INVASION OF LATERAL CHAIN OF GLANDS FURTHER RECURRENTS SUCCESSFULLY TREATED BY RADIUM AND COULIDGE X RAYS

Mrs S. January 22, 1912. Patient suffered from carcinoma of left breast (Fig 3), chronic mastitis of right breast. Radical operation was done, the left breast being removed, the lesser pectoral and serratus muscles being left.

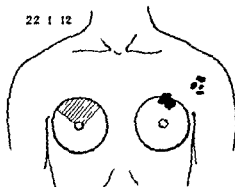


Fig 3 Chronic mastitis right, carcinoma left breast

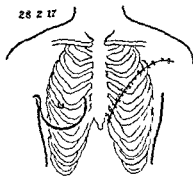


Fig. 4

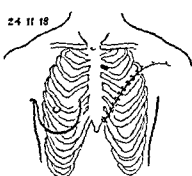


Fig. 5

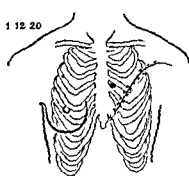


Fig. 6

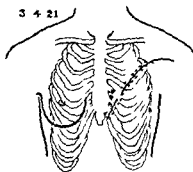


Fig. 7

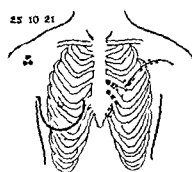


Fig. 8

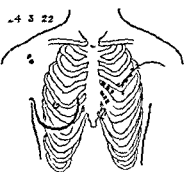


Fig. 9

July 1917 \ ray treatment given

April 18 1914 Examination showed no evidence of recurrence

February 28 1917 Nodule has appeared at upper border of the second left costal chondrosternal junction (Fig. 4)

October 18 1918 The nodule had become larger and was removed

November 4 1918 Another nodule appeared in the space below. Radium was inserted into both spaces (Fig. 5)

July 7 1919 No recurrence is evident Patient is extremely fit and is driving a car

December 1 1920 A mobile nodule is found in the fourth left space and hard glands in the right axilla. Radium was inserted in these two situations \ ray treatment was given (Fig. 6)

April 3 1921 Three nodules are seen over the fifth costal cartilage and fifth space. An operation was done and a piece of the fourth costal cartilage was removed and radium tubes were put in the fourth space down toward the ensiform and up under the costal cartilage above (Fig. 7)

June 25 1921 Radium was applied to surface for 4 hours 50 milligrams to nodules and 30 milligrams to right axilla

September 19 1 Coolidge tube \ ray applications

October 23 1921 Nodules are present over fourth fifth and sixth ribs and the intervening spaces (Fig. 8)

March 4 1922 The subcutaneous nodules are much reduced since the Coolidge treatment (Fig. 9)

June 1 1922 The superficial nodules are spreading backward along the fourth and fifth spaces and there is median extension toward the ensiform cartilage (Fig. 10). The right axillary glands are larger and a line of nodules has appeared along a main axillary lymphatic vessel. Coolidge tube \ ray treatment

October 2 1922 All of the nodules have disappeared. The gland in the right axilla are much smaller

December 6 1922 There is a mass in the right breast with a line of nodules from it to the right axilla (Fig. 11)

December 9 1922 The right breast was removed and radium inserted for 4 hours 50 milligrams in inner wall of right axilla 5 milligrams in posterior wall of right axilla 25 milligrams near the apex of the right axilla

January 8 1923 The right side is all well there are a few new nodules along the left costal margin. Further \ ray treatment was given

May 1 1923 The ulnar side of the right forearm was atrophied. Three new subcutaneous nodules were found over the eighth rib in the left midaxillary line. There were no visceral deposits

July 2 1923 Multiple small nodules were found to be present over the lower six ribs on both sides (Fig. 12)

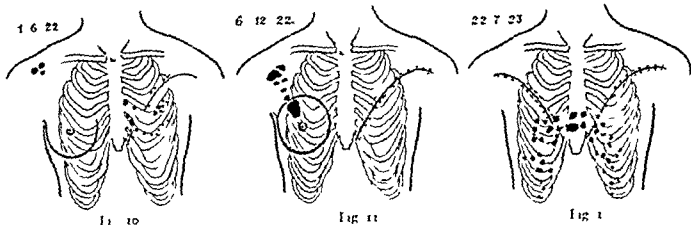


Fig 10

Fig 11

Fig 12

Oct 10 1923 The nodules are still active in the right axilla and over the right lower ribs in front and in the epigastrium. Dullness is present at the base of the left lung (Fig 13).

May 3 1924 Patient died 2 years after primary operation. Up to within a fortnight of her death the patient remained active and able to conduct her business.

Let me now give you a brief account of a Group 3 case which may be regarded as typical. This patient was operated upon for cancer of the left breast in 1920 and no doubt even then had extension of the disease in the thorax beyond the internal mammary glands for only a year later she had a sternal deposit in the lower part of the glandular, which was successfully treated by radium. In 1924 a lump developed in the manubrium but this also disappeared under radium treatment. In April 1925 no external manifestation of disease remained. She died with thoracic symptoms and signs of pressure on the left recurrent laryngeal nerve in March 1926. At the necropsy the only malignant tissue found in the body was a mass of recurrent growth in the superior mediastinum.

In this case prophylactic radium might have prevented the sternal recurrences but it would not have averted the mediastinal deposit nor would it have prolonged life. The patient came too late, and had already passed irrevocably from Group 2 to Group 3.

Mary A. aged 75 in 1924. In July, 1920, the left breast was removed at the Hampstead General Hospital. In July 1921, there was found recurrence on the left side of the sternum in the fourth interspace tenderness in the supraclavicular triangle no metastases elsewhere. Light 10 milligram tubes of radium bromide were inserted into the sternal recurrence for 28 hours.

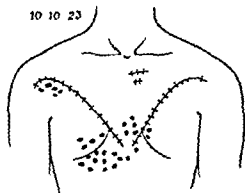


Fig 13

In August, 1922 recurrences were found at site of irradiation and at and below the old tumor site in the fourth interspace. Ninety milligrams of radium was placed in the center for 1 hour and nine 10 milligram tubes were arranged radially at the periphery for 24 hours.

In October 1922 the glands were apparently removed from the supraclavicular region on the left side but no notes can be traced of this operation or of the result of a microscopical section.

In July 1924, we found a recurrence above the old irradiation site in the middle line, firm, adherent, and almost central over the sternum. No palpable glands or metastases were to be found. Five tubes of radium totaling 16 milligrams were buried radially with part of the tubes within the periphery of the tumor 90 milligrams in the center of the tumor for 10 hours.

In August 1924 there was found complete disappearance of the recurrence.

In April 1925 examination showed no evidence of growth to be found locally or in any of the lymphatic areas draining the operation sites. The operation scar is normal and supple. The upper and lower sternal recurrence sites which had been treated by buried radium consist of flat, soft, supple white scars with no evidence of subadjacent growth. The general condition of the patient is good.

In May, 1925 the patient complained of attacks of hoarseness and loss of voice. Otherwise she is very well. There is no loss of weight and nothing abnormal.



mal can be found in the thorax. She has been seen by Mr. Clemmenson who reported that the left vocal cord was paralyzed in the cadaveric position.

In January 1926 the patient reported that she has been quite well until recently when she has been troubled with swelling of the arm and left side of the face and she has begun to lose weight rapidly. The voice is still hoarse. There are dilated veins running from the right arm over the right side of the thorax and also from the thorax down to the abdomen as if there was some obstruction to the inferior vena cava. There is no external sign of recurrence but the patient looks ill and the whole picture is highly suggestive of an intrathoracic recurrence. An X ray has been taken but it is useless as the patient could not be made to keep still and hold her breath. She has been recommended for a permanent bed.

March 9 1925 Patient has been admitted to Stafford Ward.

March 14 1926 Patient died.

*Postmortem findings.* A large mass of firm recurrent growth was found in the superior mediastinum. It was adherent to the deep surface of the sternum and the upper left costal cartilages to the clavicle to the pleura and to the vertebral column. It almost surrounded the arch of the aorta and the left subclavian and common carotid arteries. The left recurrent laryngeal nerve was embedded in it. The mass extended from just above the level of the clavicle to the third rib and from the posterior surface of the sternum to the vertebral column. From the third rib close to the left side of the sternum a small projection of the mass extended down as far as the upper border of the fifth rib. One small nodule was felt in the third intercostal space in the midclavicular line but no other secondary deposits were found. There was extensive bronchopneumonia of both lungs and the patient had two large gall stones.

*Examination of the sites of radium treatment.* 1. In 1921 and 1922 radium was inserted in the fourth space close to the left border of the sternum. At autopsy no growth was found in the skin and subcutaneous tissues but growth was found infiltrating the intercostal space directly below. This growth was in direct connection with the large recurrence in the superior mediastinum.

2. In July 1924 radium was inserted in the middle line over the upper part of the sternum. At autopsy the skin subcutaneous tissue superficial surface and marrow of the sternum all appeared healthy and free from growth but the under surface of the sternum was closely adherent to the mass in the thorax. There was no necrosis of the sternum.

A painstaking microscopic examination of a vertical section taken through the subcutaneous tissue and the thickness of the sternum showed the sternum to be quite normal. No growth was seen anywhere in the section.

3. Microscopic examination of the recurrence in the thorax. The section shows masses of spheroidal cells embedded in a well marked and very dense fibrous stroma—undoubtedly scirrhous carcinoma of the breast.

From the point of view of the treatment of local recurrences by radium, this is a most interesting case. Briefly, the history is as follows.

The original operation was performed in July 1920, one year later a recurrence in the fourth intercostal space was treated with radium and completely disappeared. Later it reappeared but radium again caused it to disappear—this time never to return. After another year August 1922 supraclavicular glands appeared and these were removed by operation. Four years after the original operation July, 1924, a sternal recurrence was treated with radium again with complete success. In May 1925 signs of an intrathoracic recurrence became manifest and the patient died in March 1926. At the postmortem examination a large growth was found in the superior mediastinum.

The patient lived for nearly 5 years after radium treatment for the first recurrence and during the first four of those years she was able to lead a perfectly normal existence except for three short periods spent in hospital for the treatment of further recurrences. Without radium treatment the patient would have certainly experienced all the troubles and discomforts which attend the presence of a large fungating mass on the chest wall. No doubt the seeds of the superior mediastinal growth which ultimately killed the patient were already present in the aortic glands when she first came under treatment.

#### PROPHYLACTIC RADIUM IN PRIVATE CASES

It is clear that to obtain the full advantage of prophylactic radium all the cases operated upon must come into Groups 1 and 2. That is not possible but in private cases as contrasted with hospital cases it is probable that the cases come rather earlier and that Groups 1 and 2 will be larger in proportion to Group 3.

Fifty six of my private patients who had prophylactic radium at the time of the radical operation for breast cancer have passed the 3 year limit and 46 of these have been followed up. Twenty six of the cases traced remained free from recurrence 3 years after operation, a percentage of 56.5. Before I began to use radium, my percentage of 3 year

successes was 47. Though I do not wish to stress the figures, there is here evidence of the value of the method. A critic might object that the difference is too small to be significant and that perhaps it is due to cases coming for operation rather earlier than in former years. In this respect, however, there has been no marked improvement as Table I shows.

TABLE I—CONDITION OF AXILLARY GLANDS WHEN FIRST SEEN

Period	No. of cases in which the condition of the glands was noted	Percentage in which hard axillary glands
Before 1915	65	73.8
1915 to 1920	106	76.4
1920 to 1925	18	69.9

It is evident that, though rather earlier than the hospital cases, my private cases on the whole were not a favorable group and that they included many Group 3 cases in which no benefit could be obtained except to avert local recurrence.

*Absence of local recurrence in the sites where the radium tubes were placed.* More definite evidence of the value of the method is to be found in the fact that as a rule when recurrence took place it was atypical in position, and did not occur at the points where the radium tubes had been placed.

Nine cases of supraclavicular recurrence were noted, but in 5 of these though radium had been used in the intercostal spaces, no radium had been used above the first rib. Of the remaining 4 cases of supraclavicular recurrence, 1 patient seen 6 years after operation had a doubtful gland above the clavicle but is still well. A second patient, an advanced case clearly belonging to Group 3, died with supraclavicular and thoracic recurrence 7 months after operation. A third patient remained well for  $3\frac{1}{2}$  years then a hard gland appeared about the middle of the anterior border of the sternomastoid. This gland was above the region protected by radium. The fourth patient remained well for  $3\frac{3}{4}$  years then developed a gland in the outer part of the omohyoid triangle, away from the protected region. In Cases 3 and 4 it may be presumed that at the time of operation micro-

scopic infection of the supraclavicular triangle had already at the time of the first operation spread beyond the gland at the lower and inner angle of the triangle which is always the earliest to show enlargement.

The most interesting case of all was one in which radium tubes were placed in the first, second and third spaces but no radium was used above the first rib. Three and a half years later the patient appeared with a hard nodule deep down in the space between the sternal and clavicular heads of the sternomastoid. This was exposed by operation and was found to be a nodule of growth occupying the interval between the junction of the subclavian and internal jugular veins and infiltrating the walls of both veins. It thus occupied precisely the situation of the terminal part of the right lymphatic duct in a position which if I had adhered to my routine, would have been occupied by a radium tube. It was transfixed accurately with a radium tube, being obviously irremovable. Twenty months later the patient remained well and free from signs of recurrence. She died ultimately of cerebral deposits 7 years after the first operation. The disease probably spread upward to the brain by permeation of the lymphatics of the deep cervical chain.

This case possesses the attributes of a laboratory experiment. The only departure from routine was the omission to insert a tube of radium above the first rib. The only recurrence was a single nodule in the exact situation which should have been occupied by the missing tube. The nodule disappeared when treated late in the day with radium. It may be inferred, with great probability, that if my usual routine had been adhered to, recurrence would never have taken place.

Perhaps the most striking fact remains. In the whole series of cases, recurrence in the intercostal spaces was noted only five times. In only a single case did the recurrence occupy a space which had been protected by a prophylactic radium tube. In the 4 other cases, the spaces protected by radium—the spaces that is to say in which recurrence usually takes place—remained free though lower spaces were attacked. Presumably in these cases microscopic invasion of the lymphatic tract

had already when the tubes were used, spread beyond the range of their influence

The solitary case in which recurrence took place in a space protected by radium only 3 months after operation is an apparent rather than a real exception to the rule. The recurrence was close to the anterior axillary fold not at the inner end of the space. No doubt at the time of operation permeation had already spread some distance backward along the lymphatics comitant to the intercostal artery and beyond the range of the radium tube at the inner end of the space.

In conclusion I would not claim to have produced a scientific demonstration of the value of the prophylactic use of radium in breast operations but only to have given such substantial evidence of its value as to establish its claims to serious attention. In the absence of evidence that any risk attends the

procedure it is my definite opinion that the precaution should not in future be omitted.

As we get our cases earlier prophylactic radium will become more and more valuable. I am convinced that its use definitely extends the possibility of cure to cases in which it was formerly excluded, cases namely in which the earliest stage of invasion of the chest is already present when they are first seen.

In order to find the reason for the increased gravity of prognosis associated with enlargement of the axillary glands we must turn to the parasternal glands of the internal mammary chain. If the axillary glands are infected then probably so are the parasternal glands. The clearance of the axilla is easy and locally effective but our results have been marred by a failure to recognize and deal with the more subtle and clinically unrecognizable process of parasternal invasion.

## ADENOFIBROMA AND FIBRO-ADENOMA OF THE SMALL BREAST

By JOSEPH McFARLAND M.D. PHILADELPHIA

TWO of the chapters in the book entitled *The Breast Its Anomalies, Its Diseases, and Their Treatment*, by John B. Deaver and Joseph McFarland, undoubtedly left much to be desired from many points of view, and prompted the junior author to investigations that might throw additional light upon the subjects with which they dealt.

The first topic had to do with the cystic diseases of the breast, and led to a research in which an attempt was made to approach the subject through a study of supposedly normal breasts, with the idea of connecting previous physiological activities with later morphological alterations. In the results, which were published,<sup>1</sup> it was pointed out that certain histological appearances, not previously understood, and much feared as the probable beginnings of cancer, were but harmless survivals of antecedent secretory activities, and probably in no manner related to malignant disease.

The second topic, which forms the burden of the present contribution, deals with the more common of the fibro epithelial tumors, and the differences, if any, that obtain between tumors known as adenofibromata and fibro adenomata.

The primary difficulty that led to the unsatisfactory character of the chapter in the monograph referred to, lay in the confused state of the terminology used in describing these tumors, and inability to successfully harmonize the terminology in the limited time the author had at his disposal when preparing the book for publication. Things undoubtedly the same were called by different names, and different things by the same name. In some cases the denominations were correct, in some only partly correct, in some without any justification. But what was worst of all, numerous cases, classed as tumors, and called by many different names, all signifying tumors, were found not to be tumors at all.

<sup>1</sup> McFarland J. Residual lactation acini in the female breast: their relation to chronic cystic mastitis and malignant disease. Arch Surg 1922 V 74

It seemed to be pretty generally understood that two principal types of non malignant fibro epithelial tumors occurred in the human breast, both "adenomata," but one appearing in youth as a well circumscribed firm nodular growth histologically made up of an abundant soft fibrillar tissue through which duct like structures, frequently deformed by intracanalicular growths, ramified, while the other, most common in the breasts of mature women, and less well circumscribed, was soft because composed chiefly of glandular tissue.

I or the first of these the most popular name seemed to be adenofibroma, for the second, fibro adenoma. But in not a few cases the terms were used interchangeably, so that it was necessary to begin by finding out whether the general understanding above mentioned was justified or whether in reality the two tumors were the same.

In order to secure enough material from which to draw reasonably accurate conclusions, friends, pathologists to 5 large hospitals, were asked to assemble from their surgical and laboratory collections, all the tissues designated by these names, or others suggesting relationship with them. The result was about 300 tissues that had been indexed under 33 different names.

Although seeming to be elaborate, the nomenclature was reasonably consistent in itself, and based upon sound scientific principles, that may be expressed as follows:

1 A benign tumor in which glandular units, with epithelium regularly disposed upon a basement membrane, are distributed throughout a supporting stroma of connective tissue, is an adenoma.

2 As the parenchymatous elements in many such tumors are less conspicuous than the fibrillar tissue stroma, leaving one in doubt whether the tumor be more properly regarded as of fibrillar tissue or of glandular tissue, it seems wise to give such tumors a special designation such as adenofibroma.

3 In case the parenchyma preponderates

over the stroma, a reversal of the form is used, fibro adenoma

4 As in mammary tumors the fibrillar tissue seems to be derived from the periductal tissue Warren has called such tumors periductal fibromata

5 As the fibrillar tissue is not infrequently very soft and like mucous tissue it seems legitimate to further characterize such tumors as periductal myxomata

6 When the stromal tissue is excessively cellular altogether or in parts some prefer to give such tumors the name periductal sarcomata

7 As the arrangement of the periductal tissue with reference to the parenchyma is peculiar sometimes surrounding the ductules in a kind of concentric manner sometimes growing into it in the form of rounded polypoid masses names suggesting these relationships are used Pericanalicular periductal fibroma or pericanalicular adenofibroma intracanalicular periductal fibroma or intracanalicular adenofibroma

8 Adding these to the already given names by which the other peculiarities of the tumors are known we find pericanalicular periductal myxoma or pericanalicular myxo adenofibroma pericanalicular periductal sarcoma or pericanalicular adenosarcoma intracanalicular periductal myxoma or intracanalicular adenomyxoma intracanalicular periductal sarcoma or intracanalicular adenosarcoma

9 To describe the more rare cases in which the parenchymatous element seems to preponderate the names simple adenoma pure adenoma racemose adenoma acinous adenoma have been employed

10 Should any of the parenchymatous elements become cystically dilated some have thought wise to name the tumor cystic adenofibroma adenomyxoma adenosarcoma etc

11 Any kind of a papillary excrescence projecting into one of the ducts has suggested the employment of such terms as papillary cystadenoma intracystic papillary adenofibroma papilliferous cystic adenofibroma

Chief interest centered about those tumors that had been called fibro adenomata, and it was uncertainty as to the significance of that term that threw confusion into the whole

TABLE I—NOMENCLATURE

Name under which the tissue was included	Total			Totals
	Tumors	Included	Non included	
Adenoma	1	1	0	2
Adenofibroma	8	2	48	58
Adenofibromyxoma	3	0	0	3
Adenomyxofibroma	8	1	2	11
Adenomyxosarcoma	0	0	1	1
Cystic adenofibroma	0	0	3	3
Cystic adenomyxofibroma	0	0	1	1
Cystic adenomyxoma	1	0	0	1
Cystic fibro adenoma	0	1	0	1
Cystic fibroma	0	0	1	1
Fibro adenoma	6	3	18	27
Fibro adenomyxoma	1	0	1	2
Intracanalicular adenomyxofibroma	8	2	1	11
Intracanalicular fibromyxadenoma	0	0	1	1
Intracanalicular adenofibroma	6	0	2	8
Intracanalicular fibroma	2	0	0	2
Intracanalicular myxofibro-adenoma	1	0	0	1
Intracanalicular myxofibroma	2	0	0	2
Intracanalicular periductal fibroma	3	0	0	3
Intracystic papillary fibro adenoma	0	0	1	1
Myxadenofibroma	1	0	0	1
Papillary cystadenoma	0	1	0	1
Papilliferous cystadenoma	0	0	1	1
Pericanalicular adenofibroma	0	0	1	1
Pericanalicular adenomyxofibroma	4	1	1	6
Pericanalicular cystadenofibroma	0	0	2	2
Periductal adenofibroma	2	0	0	2
Periductal adenomyxofibroma	0	0	0	0
Periductal fibroma	7	2	16	25
Periductal fibro adenoma	1	0	1	2
Periductal myxofibrocytadenoma	0	1	0	1
Periductal myxoma	3	1	0	4
Periductal sarcoma	1	1	0	2
	71	17	10	198

subject of the fibro epithelial tumors by appearing now in one now in another category

The entire nomenclature used in the two largest hospitals is shown in the following tabulation of 190 tissues there found

The collected material represented the work of a succession of competent pathologists assisted by many resident physicians on the pathological service The extensive and diversified terminology was no doubt the result of sincere efforts on the part of all to be as accurate as possible but it was bewildering and unnecessary What were these things the same or different? If the same why use so many names if different, how do they differ?

One clear cut tumor there seemed to be and the name by which it could be called without any ambiguity was *periductal fibroma* It was decided to begin by examining all of the material with the microscope laying aside all of the periductal fibromata and modifications

of them, and then analyze and study the remainder

The custom in vogue in many hospital laboratories of marking the sections with a number only facilitated this phase of the work by permitting each section to be studied without prejudice based upon what some former examiner had called the tissue. Known only by number, each slide was studied, and the diagnosis and peculiarities carefully noted for future reference, when the second part of the investigation, that dealing with the case histories, was to be pursued.

Not many cases had been examined before one was encountered in which there was no vestige of a tumor—only normal breast tissue was found. It was supposed to be an accident resulting from the wrong tissue having been sent to the laboratory, or the wrong piece worked up by the technician, though the fact that it had been described as a tumor was disconcerting. It was thrown out, but later, when the same circumstance had been repeated a number of times, it seemed necessary to take notice of it, so it was decided to make two chief classes of material, called respectively, *tumors* and *non tumors*.

Curiously as the studies were continued, the non tumor class outgrew the tumor class. There also appeared a number of cases the true nature of which it was impossible to decide. At one examination they were thought not to be tumors, at another, to be such. Upon later re-examination they were returned to the tumor group, later to be removed from it again. These perplexing tissues were finally grouped together as a third group to which the name *indeterminates* was given.

At the close of the first part of the investigation the grouping of tissues stood tumors, 105, non tumors, 147, indeterminates, 37, making a total of 289 different tissues studied and found useful for further analysis, the others having been thrown out because of some such reason as faulty technique or inadequate material.

The next step consisted in attempts to correlate the histological findings with the case histories, and resulted in many tiresome hours spent in the record rooms of the various hospitals. Unfortunately, the desired and some-

times the most important data were not forthcoming in a good many of the cases, and the data obtained varied for different cases. Thus, those upon which age data were obtained, were not either the same cases, or in the same number as those for which matrimonial data were available. Though it is always disappointing not to find in the case histories the facts most useful in the investigation under way, it can not always be expected. It is only natural that a surgeon about to remove, under local anesthetic, a small tumor of the breast, will disappoint some pathologist, who 10 years later may be most anxious to learn whether the operation was performed at the time the patient was menstruating, or in the interval between the periods, yet just such information is of the greatest importance when any mammary condition is under investigation.

It was necessary to utilize to the best advantage the data found, and what has been said is in explanation of the differing numbers of cases figuring in the various computations and tabulations that follow.

The data obtained are displayed in Tables II and III.

The case histories having been read and the useful data collected, the cases were assembled into groups corresponding with those resulting from the histological studies, that is, tumors, non tumors, and indeterminates, after which the whole of each group, then each of its parts, was plotted and compared.

Figure 1, in which, as in all charts that follow, the ordinates represent numbers of cases, while the abscissæ represent years of age, shows the age distribution of all of the cases of all kinds—that is, tumors, non tumors, and indeterminates, the average age being 32 years, and the mean, 33 years. The curve is almost identical on each side of the mean and average points, and regularly covers the entire period of the sexual life of the woman, beginning at about puberty, reaching its highest points in maturity, and rapidly declining after the menopause.

But as this chart is made up of all three of the groups into which the material was divided, it was, of course, necessary to analyze it into its several components, in order that they might be satisfactorily compared.

TABLE II — FINDINGS IN ONE HUNDRED SIXTY EIGHT CASES

## I Tumors

1 Marital state not known	
a Age not known	30
b Less than average of 32 years	3 39
c More than average of 32 years	1
Unmarried	
a Age not known	31
b Less than average of 32 years	31 38 100
c More than average of 32 years	4
3 Married	
a Age not known	31
b Less than average of 32 years	12 81
c More than average of 32 years	131

## II Indeterminate cases

1 Marital state not known	
a Age not known	0
b Less than average of 32 years	0 1
c More than average of 32 years	1
2 Unmarried	
a Age not known	0
b Less than average of 32 years	2 7 37 259
c More than average of 32 years	2
3 Married	
a Age not known	0
b Less than average of 32 years	2 9
c More than average of 32 years	7

## III Non tumors

1 Marital state not known	
a Age not known	47
b Less than average of 32 years	0 40
c More than average of 32 years	2
Unmarried	
a Age not known	
b Less than average of 32 years	17 34 14
c More than average of 32 years	15
3 Married	
a Age not known	4
b Less than average of 32 years	10 64
c More than average of 32 years	50

Figure 3 shows the curve formed by the tumor cases. The average age of this group is .8 years and the curve is almost entirely confined to the early half of sexual life. Beginning at about puberty, the curve rapidly rises, its highest point being reached at the nineteenth year after which it gradually declines until after the thirtieth year when only an occasional case occurs. This chart shows the age at which the patients were operated upon.

Figure 3 shows the tumor cases of married and single women at the ages at which it is stated that the tumors were first discovered. It repeats the curve seen in Figure 2 and differs from it only in that the number of cases in which the age data were given was smaller (47 instead of 60 cases) and that this treatment of the data has the effect of diminishing the average age of the patients to .6 years.

TABLE III — CONSIDERATION BY AVERAGES OF AGE DATA OF DIFFERENT GROUPS

I Tumor Cases	A Unmarried women	
	a Average age at time of first discovery	0
	b Average age at time of operation	2.8
II Indeterminate Cases	B Married women	
	a Average age at time of first discovery	3.2
	b Average age at time of operation	3.8
III Non tumor Cases	C Unmarried women	
	a Average age at time of first discovery	3.2
	b Average age at time of operation	3.5
	D Married women	
	a Average age at time of first discovery	3.8
	b Average age at time of operation	3.8

The question next arose as to the effect of separating the unmarried and married groups and constructing a curve for each. With such increase of required data, the number of cases diminished rapidly so that the sources of error multiplied but it seemed possible to arrive at some useful information. Figure 4 shows the curve of tumor cases in single women. The general character of the curve is unchanged but with the exception of 5 cases the entire group becomes centered in the first half of the age distribution. However the curve for the married women Figure 5 is quite different. In reality there is no curve but almost an

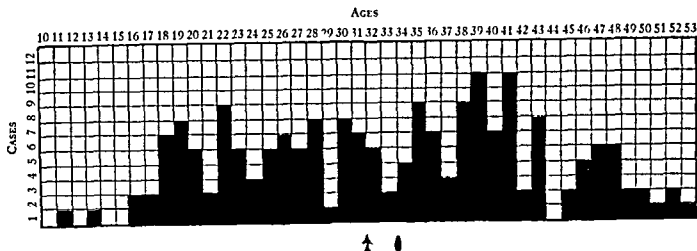


Fig. 1. The age distribution of all cases of all kinds. The average age is shown by the arrow, the mean point by the oval. There is a fairly regular ascent from the left and descent to the right forming a regular curve covering the whole period of sexual female life from puberty to the menopause.

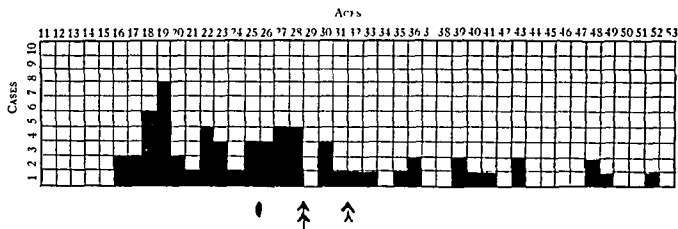


Fig. 2. The age distribution of the tumor cases of married and unmarried patients at the time of operation. The arrow shows the average age in all cases, 29 years; the double arrow, the average of this group, 39 years; the oval, the mean point. There is a characteristic curve rising suddenly between the sixteenth and nineteenth years, and then gradually declining. Three fourths of the cases are to the left of the average age line for all cases.

equal number of cases at all ages from maturity to the menopause.

Taking next the non tumor cases, the first plot, Figure 6, shows the curve for married and single women at the age of operation. In a general way, it is exactly the reverse of that of the tumor cases, for it begins at about puberty, rises gradually, and reaches its highest point about the fortieth year, after which it rather rapidly declines.

If those cases concerning which the age of first occurrence is known be separately plotted, Figure 7, the general character of the curve is unchanged, and the highest point, as well as the majority of the cases, are in the latter half of sexual life.

But when the cases of married and unmarried women are separated and charted independently, a difference similar to that found in the separation of the tumor cases, married and unmarried, makes its appearance.

Thus, Figure 8 shows the non tumor cases in married women, at the age of first occurrence. It differs only in the slightly later average age of the patients. But Figure 9, which shows the plot of the unmarried women at the time of the first appearance of the non tumor lesions, is entirely different in presenting a regular curve regularly extending over the whole of the sexual life from adolescence to the menopause, the average age of the patients, the average age of all, and the mean



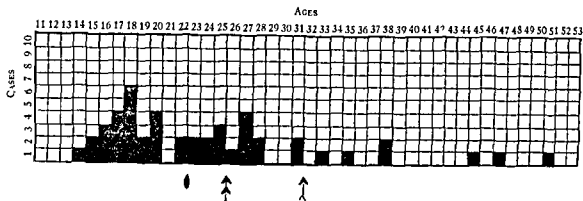


Fig 3 The age distribution of the tumor cases married and unmarried at the time the lesion was first discovered. The average age is 26 years. The single arrow shows the average age for all cases, the double arrow the average age for this group, the oval the mean point.

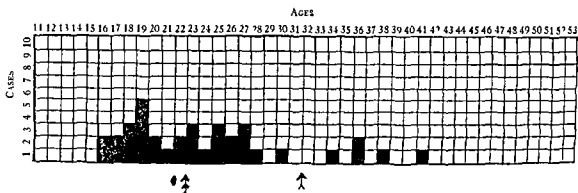


Fig 4 The age distribution of the tumor cases in unmarried women. The average age for the group is 23 years. The curve rises and falls to the left of the average age for all and differs from that shown in Figure 3 only in making the average age 3 years earlier. The arrow shows the average age for all cases, the double arrow the average age for the group, the oval the mean point.

points all being very nearly in the same place.

Taking next the indeterminates of which too few were accompanied by satisfactory age data, the general plot Figure 10 showing all cases of married and single women, can scarcely be said to form any curve at all. But remembering that they may really have belonged either to the tumor class or to the non tumor class, one has a right to inquire how the respective curves of those classes might be modified by combination with them.

Figures 11 and 12 were therefore prepared. Figure 11 to show all tumor cases plus all indeterminates, and Figure 12 all non tumor cases plus all indeterminates. In order to have the greatest possible number of cases, the

plotting was done with the use of the ages at which the patients were operated upon. It will be seen at a glance that the general tendency of the respective curves is in no way changed by the additions.

It is now quite evident that the cases called tumors have their greatest incidence some 10 years earlier than those of the group called non tumors. Is there any way to account for this difference? Have the different histological conditions something to do with maternity? The great majority of the non tumor patients were married and most of them had had children in all probability. Plottings were made of the tumor cases known to have had children Figure 13 and of the non tumor cases known to have had children, Figure 14.

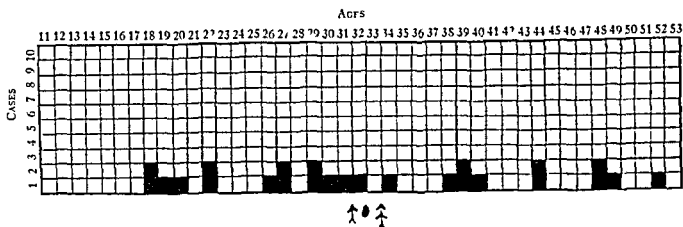


Fig 5 The age distribution of the tumor cases in married women the average age for the group being 34 years In this case there is no curve

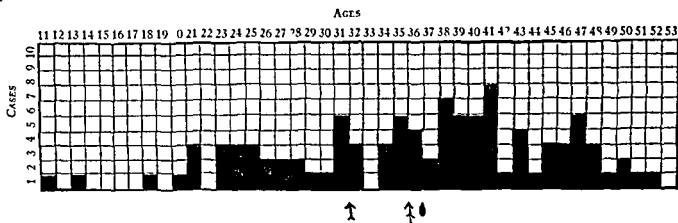


Fig 6 The age distribution of the non tumor cases at the time of operation It includes both married and unmarried women the average age for the group being 36 years A curve is formed that beginning at maturity gradually ascend finding the highest point about the forty first year then gradually subsiding This curve is in the opposite direction to that formed by the tumor cases the highest point and greatest number of cases being to the right of the average age for all cases

Although the number of cases is so small that errors may be great, it is interesting to see that no change occurs in the curves normal to the respective classes. The average age of the tumor cases is 28 years, and nearly all are in the youthful period, while that of the non tumor cases is 35 years, and the greatest height of the curve is about the fortieth year, most of the cases being in the latter half of life.

From this it seems probable that it is age and not maternity that determines the distribution of the tumor and non tumor cases.

When all things are considered, the analyses and plottings seem to show the following facts:

1. The "tumors" are lesions of the first half of sexual life (average age of the patients 28 years), appearing with adolescence, increasing rapidly until the period of full sexual activity, then gradually declining in numbers.

The firmness of the juvenile breast, as contrasted with its later softness, makes it probable that the discovery of some of the more deeply situated tumors is not made until, after lactation or the menopause, the patient is easily able to feel them.

2. "Non tumors" are lesions occurring chiefly in the second half of sexual life (average age of the patients 37 years), and in married women. It is true that 32 cases occurred in unmarried women, but their age curve seemed only to show that a few cases occur at all ages.

3. "Indeterminates" like the "non tumors" in unmarried women, scatter themselves in about equal numbers over the whole period of sexual life.

4. As the "tumor" cases among married women that had had children were four times

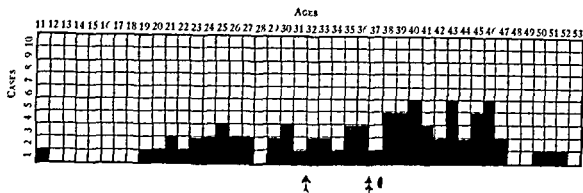


FIG. 7 The age distribution of the non tumor cases unmarried and married at the time when the disturbances were first observed. The average age for the group is 37 years. There is no difference in the curve shown on the chart and that on the chart in Figure 6.

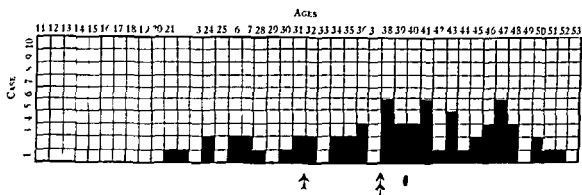


FIG. 8 The age distribution of the non tumor cases in married women at the time at which the disturbances were first noted. The average age rises to 38 years and only 1/3 of the cases are on the left of the average age for all cases.

more frequent prior to the average age for all cases and the non tumor cases twice as frequent after it there seems to be reason to suppose that it is age and not maternity or matrimony that determines the difference between the lesions.

Of 41 tumor cases with the necessary data the average pre operative duration of the lesions was 4 years. Many were naturally of much longer duration—16 12 12 12 10 10, 10, 7, 6 5 and 5 years respectively. In a few cases the duration was said to have been very short—8 6 and 3 weeks. As the patients would naturally suppose that their first observation of the respective tumors coincided with their first appearance their statements in regard to them must not be given too much weight. However as short duration plays an important role in the non tumor cases it must not be slighted here.

Of 69 non tumor cases with similar data the average duration was found to be 1 year 9 months and 1 week. The greatest variations in the pre-operative duration were found in this group. Many were known to have existed for long periods—18 10, 10 10, 8 8 7 6 6 5 5 5 and 4 years respectively. Others were said to have existed only for weeks and a few for days only—10 10 5 and 3 days.

It now seems advisable to make a careful analysis of the acquired data regarding each of the major groups beginning with those designated "tumors," which will hereafter be known by that name believed to be appropriate for all, periductal fibroma.

#### THE TUMOR GROUP PERIDUCTAL FIBROMATA, ADENO FIBROMATA, ETC

Of the 105 cases whose histological structure placed them in this class, the average age was

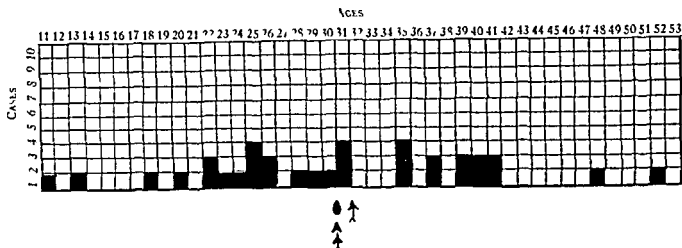


Fig 9 The age distribution of the non tumor cases in unmarried women at the time the disturbances were first detected. There is a regular curve the highest point being the average age for all cases the average age for this group and the mean point coincide.

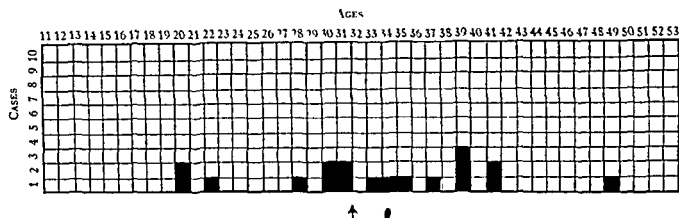


Fig 10 The age distribution of the few indeterminate cases with the necessary data. It includes both married and unmarried women and shows the age of operation. There seems to be a regular curve at the high point of which the average age for all cases the average age for this group and the mean point all cluster.

26 years at the time the lesion was first discovered. Only 26 per cent of the patients were married, only 10 had borne children. The average pre operative duration of the lesions was 4 years, the extremes being 16 years and 3 weeks. In 4 cases the lesions were multiple in one breast, in 4 multiple in both breasts. In 19 cases they were in the right, in 22 in the left breast. In 2 cases the tumor was described as "sensitive", in 12 cases it was expressly stated that there was "no pain". In 4 cases the tumor was said to "become larger during the menstrual periods".

In 27 cases the size of the tumor was compared to a walnut in 7, to a hen's egg in 7, to an olive in 3, to an almond in 2, to a marble in 1, to a cherry in 1, to a hazelnut in 1, to a lemon in 1, to an orange in 1, and to a grape fruit in 1.

In nearly all cases it was stated in the pathological description, that the tumor was "well encapsulated". But in the case reports the expressions employed by the surgeons in describing their operations, leave one in doubt as to exactly what they found. Thus, in 11 cases a tumor is said to have been "removed", in 3 it was "shelled out", in 3, it was "dissected out with scissors", in 2, "enucleated", in 9 "dissected out", in 11, "excised", in 1, "a small fibro adenomatous growth was excised", in 1, a "small hard mass, evidently a fibroma, was excised", and in 1 case "the breast was amputated".

The tumors usually occurred as more or less bosselated nodes. Rarely they consisted of several, or even numerous, closely approximated nodes or coalescent nodules. Each node or nodule was composed of fairly uniform

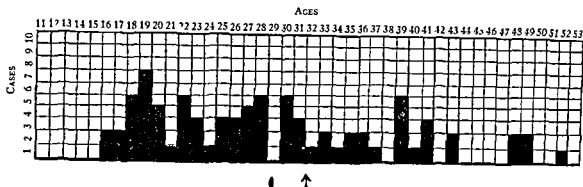


Fig. 11 The age distribution curve of all of the tumor cases plus all of the indeterminate cases at the time of operation. When compared with Figure 2 the curve shows no change in general character.

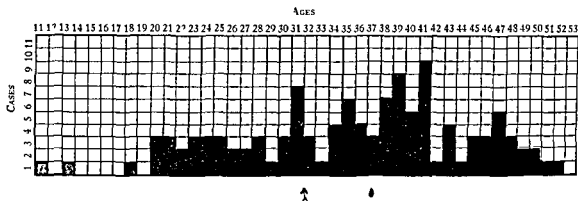


Fig. 12 The age distribution curve of all of the non-tumor cases married and unmarried plus all of the indeterminate cases at the time of operation. By comparison with Figure 6 it will be found that the general character of the curve is unaltered.

pinkish gray fibrillar substance the cut surface of which being under tension bulged convexly when the tumor was cut in half and appeared finely fasciculated.

The presence of adipose deposits in the tumors was observed in two or three cases only, those being large tumors made up of several fairly distinct nodes between which small groups of fat cells occurred. In no case were fat cells observed in the tumor nodules themselves. This may be explained through the homology between the stroma of the tumor and the periductal tissue of the breast into which fat cells were seen to penetrate only once in more than 200 cases studied.

Careful inspection of the cut surface usually reveals a number of short straight or curved slits or crevices which are the duct like structures composing the parenchyma. Their number and size differ in different tumors, and in

some they appear larger and rounder because distended with secretion. When very large, they may give the tumor a "cystic" character. They are more numerous and more obvious in those tumors that are said to have suddenly become larger or grown rapidly, and are most so in tumors that grew from a small to a large size in the course of days, in which there may be large numbers of large cystic spaces filled with fluids whose varying appearance run the gamut of mammary secretion from watery fluid thin milky fluid milk to thick rich yellow cream. The rapid enlargement of the tumor thus becomes explained through its secretory activities and not through the growth of its tissues although remarkable changes in them may also be found as will be pointed out when the histology is considered.

Large tumors are apt to have many good sized cysts into which rounded polypoid or

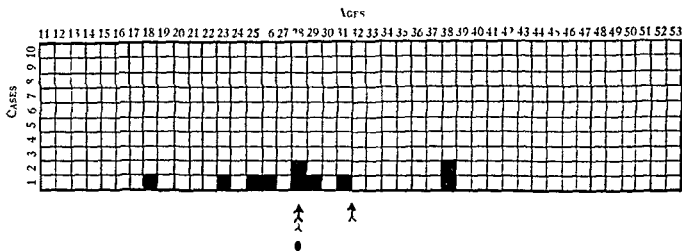


Fig. 13 The age distribution of tumor cases in married women having children at the time the disturbances were first observed. All but two cases are to the left of the average age for all cases, the average age for the group being 28 years. Compare this chart carefully with Figure 14 and see how the one is the reverse of the other.

fungous excrescences project, and very large tumors may have cysts of great size with such excrescences as large as the terminal joints of the fingers.

Microscopic sections of these tumors never show a structure corresponding with that of the mammary gland, but with one of its lobules. It is made up of finer or coarser connective tissue, analogous with the periductal tissue, through which course single ductules or systems of ductules terminating in blind ends frequently dilated into caecal pouches.

The connective tissue represents the periductal tissue of what seems to correspond to an exaggerated mammary lobule, the ductules correspond to those ordinarily found in a lobule. Such correspondence in structure gives the impression that the tumor may arise through enlargement of a lobule or a group of closely approximated lobules, each of which contributes a node to the general nodular structure of the tumor.

The proportion of ductules to stroma differs in different cases. Usually there seem to be about as many as commonly occur in a mammary lobule. But there may be fewer, and occasionally so few that the tumor may be mistaken for a fibroma, or there may be many more than normal. The comparatively rare cases in which acini make their appearance will be discussed later.

The epithelium lining the alveoli is usually regularly disposed in a single layer of cuboidal cells, though in some cases two layers—

secretory and basket cells—may be met. The cells are not always of the cuboidal shape, they may be tall and columnar, or elongated. In a case studied at the Pennsylvania Hospital through the kindness of Dr. John R. Paul, they appeared in the form of large spindles, and in such numbers as entirely to fill the alveoli, and perplex the observer. It is quite common for the cells to be unequal in distribution in a single layer, for the most part, they sometimes fade away over the intracanalicular polypoid growths soon to be mentioned, or pile up in the deeper recesses between them. Such irregularities seem to be of no significance, and must not be thought of as indicative of "malignant" tendency. The number of periductal fibromata proving to be malignant falls to zero when clinical proof of the supposed histological indication of malignancy is demanded.

The fibrillar tissue of the stroma varies in different tumors, and in different parts of the same tumor. In some tumors, and in parts of tumors it is very fine and loose, resembling that of the nasal polyp, in other tumors or parts of tumors it is coarse and relatively dense. Attempts to correlate the density of the stroma with the age of the tumor were unsuccessful, possibly because not all parts of the tumors were of the same age.

The proportion of cells to fibers also varied. In some tumors, and some parts of tumors, there were very few cells, in others so many as to suggest the possibility of sarcomatous

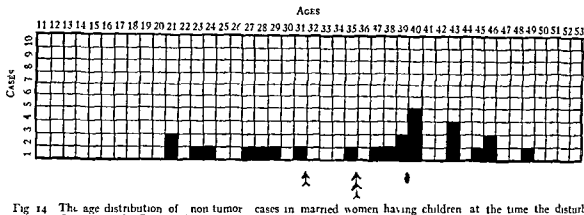


Fig 14 The age distribution of non tumor cases in married women having children at the time the disturbances were first detected Two-thirds of the cases are to the right of the average age for all cases the average age for the group being 36 years

growth In a few tumors the matrix consisted almost entirely of spindle cells—adenosarcoma The fungoid ingrowths of the intracanalicular tumors were almost always composed of loose fine fibrillar tissue and sometimes of oedematous myxoedematous or, indeed mucous tissue

The perilobular mammary tissue is thrust aside as the periductal tissue increases in quantity to form the capsule by which the tumor is surrounded

Among the 105 tumors there was one no larger than a pea and one as large as a goose egg with all the intermediate sizes As the smallest were for the most part intracanalicular tumors it seemed natural to suppose that it was in that form that they usually arose but as some of the large intercanalicular tumors showed the intracanalicular projections only in parts of their structure it is not impossible that they may be also a late development in tumors of other varieties

It will not now be *malapropos* to consider briefly the specific varieties of the tumor

1 *Intracanalicular periductal fibroma* As there were 63 or 60 per cent intracanalicular periductal fibromata in the series of 105 this variety evidently occurs more frequently than any other It is characterized by local swellings of the stroma that take the form of ingrowths of polypoid shape that project into and stretch the alveoli transforming them from rounded cylinders to flattened spaces spread over the polypoid excrescences The intracanalicular ingrowths vary in size ac-

cording to the age and size of the tumors When the tumors are small they may be so minute as barely to be seen, when they are large they may equal the end joint of the finger The larger excrescences are not infrequently devoid of epithelial coverings as though the stretching had drawn them apart The recesses on the other hand are frequently filled with what seems to be an excess of cells

2 *Intercanalicular periductal fibroma* Twenty one or 20 per cent of the series were intercanalicular periductal fibromata a not generally recognized variety The stroma consisted of a soft loose periductal tissue through which ductules and systems of ductules terminating in several slightly expanded endings regularly and uniformly ramified The stroma showed no definite relationship to the parenchyma, that is it neither grew into it nor surrounded it concentrically

In a few cases the ductules terminated in complicated branched endings some such tumors having been removed from patients known to have been pregnant

Tumors removed from patients known to have been lactating either contained aggregations of acini or were so largely composed of them as to give the impression of an entirely different genus of tumor Such in appearance probably explains why similar tumors have been described as "simple adenoma," "mammary adenoma," "alveolar adenoma" etc

3 *Pericanalicular periductal fibroma* No tumor regularly presenting a concentric

arrangement of the periductal tissue about its tubules was found among the 105 tumors examined, but in two cases such arrangement was found in parts of tumors otherwise frankly of the intracanalicular type.

This seems to prove the rarity of the pericanalicular variety among the tumors of the female breast. But in another series, made up of tumors from male breasts, the periductal arrangement of the stroma was frequent. It seems, therefore, to belong to tumors of the male rather than of the female breast.

As the fibrillar, myxomatous or cellular type of the stroma of these tumors has been made an excuse for further dividing them into fibromata, myxomata, and sarcomata respectively, it seems worth while to examine these conditions more particularly.

a Periductal fibroma. In the periductal fibromata the stroma was fibrillar without mucoid, and without excessive numbers of fibroblasts. The fibers were sometimes very fine, sometimes very coarse. A few tumors with dense coarse fibers throughout had a known pre-operative duration averaging 13 years, a few with very fine fibers averaged only 4 months. It seemed as though duration had something to do with the quality of the stroma, and it was surmised that when parts of the same tumor showed both types of tissue the coarser was the older. But one tumor composed entirely of finely fibrillar and myxoid stroma, is known to have existed for 18 years, one with finely fibrillar stroma highly fibroblastic in spots, had existed for 5 years, one coarsely fibrillar, but fibroblastic in spots, was only 18 months old, while another coarsely fibrillar in some parts and finely fibrillar in others, had existed for 6 years. Other factors than age therefore probably play a part in the modification of the histological structure of these tumors, so that one may not predict from the age what its histological structure will be, nor by a histological examination of the tumor tell its age.

b Periductal myxoma. Many of the tumors described under the name of periductal myxoma proved upon more careful examination to be adenomatous and not myxomatous. The oedema did not, as a rule, affect the entire tumor. It chiefly occurred in the intracanalicu-

lar variety, presenting itself for the most part in the intracanalicular polypoid excrescences.

It was not always simple oedema, but was frequently attended with the presence of a certain amount of mucus, so that it seems justifiable to call it myxoedema. As a certain quantity of mucus was found in the interstices of the stroma of the healthy breast in 75 per cent of those organs examined, it is in no way remarkable that it should be found in tumors of the organ.

But in a few of the tumors, true mucous tissue was present—that is, tissue characterized by the presence of the “star like reticulum.” It did not occur in any tumor with a pre-operative duration of less than 1 year, and the average age of those showing it was 3 years.

c Periductal sarcoma. This variety is characterized by a stroma so cellular or fibroblastic as sometimes to seem to be composed of cells only. In many cases the short spindle cells are not to be differentiated from those of sarcoma, hence the name periductal sarcoma. But not all of the tumors are equally cellular throughout, many are highly cellular in certain areas only, the remainder being of the usual fibrillar appearance.

It seems to be pretty well understood that such supposedly periductal fibromata as later show themselves to be malignant, do so through sarcomatous behavior and not through carcinomatous change. What then may be the relation of excessively cellular stroma to sarcoma? If parts of the tumor are excessively cellular may it not indicate only that those parts were growing more rapidly than the remainder? Does excessively cellular structure throughout indicate simply that the whole tumor was growing rapidly?

Tumors supposed to be periductal fibromata have been known to grow very slowly for years, then to begin a much more rapid growth, and to show upon microscopic examination an excessively cellular stroma thought to be indicative of sarcoma—indigenous sarcoma of the breast. Were they really originally periductal fibromata, or were they sarcomata from the beginning? The stroma of one small tumor of the present series was entirely made up of small spindle cells, and



was called sarcoma although it contained the usual parenchyma distributed according to the plan here called intercanalicular. Unfortunately the postoperative history of the case could not be traced. All that is known is that the patient never returned to the hospital for additional treatment or advice.

As a matter of fact not one of the patients, with excessively cellular tumors cellular throughout or only in parts is known to have returned because of tumor recurrence or other manifestations of malignancy.

One interesting case was successfully followed. It was a tumor in the breast of a girl 17 years old, where it had been for years, growing very slowly until shortly before removal when it had begun to grow rapidly. It had a very cellular stroma, and was reported upon by the pathologist as a spindle cell sarcoma or to use his own words, as an 'adenofibroma that had undergone sarcomatous degeneration. The patient is living and well, four years after its removal, there having been no recurrence of the tumor.

It seems scarcely justifiable to regard periductal fibroma, periductal myxoma and periductal sarcoma as other than variations of the same thing.

Most writers make mention of the intracanalicular and pericanalicular but scarcely any of the *intercanalicular* periductal fibromata. It was in his *Textbook of Pathology* published in 1904 that the writer first pointed out the existence of the last mentioned type, and showed its structure by means of a diagram. Further attention was directed to it in his *Surgical Pathology* and the same diagrams published in 1914. Its importance will perhaps best be evidenced by the following histological tabulation of the 105 tumors.

	Case
Intracanalicular periductal fibromata (60 per cent)	63
Intercanalicular periductal fibromata (20 per cent)	21
Combined intra and intercanalicular periductal fibromata	1
Pericanalicular periductal fibromata	0
Intra and pericanalicular periductal fibromata	2
Nondescript i.e. not for some reason classifiable	8
Tumors modified by acknowledged or suspected pregnancy	6
Tumors modified by lactation	4
	105

It was usually easy to recognize the lactating tumors, both by the hypertrophy of their parenchyma, and by the presence of secretion in their ducts and acini. In one tumor, removed just before lactation began on account of rapid increase in size and the fear that it was malignant, the whole tissue was glandular and acinar, in another removed after lactation had begun the ducts were greatly distended with a thick yellow cream.

Arguing from such cases it seemed as though the tumor tissue ought to show changes characteristic of pregnancy. If the lactating tumors just mentioned showed lactation hypertrophy at its height, tumors removed during pregnancy ought to show the beginning and progress of the mammary hypertrophy according to the duration of pregnancy. It may do so but the number of cases with accurate data upon the existence of pregnancy were too small to enable a conclusion to be reached and there were a few contradictory evidences.

Remembering that enlargement and sensitiveness of the mammary glands is one of the first signs of pregnancy we thought it possible that sensitiveness of the tumors might throw some light upon the problem but a review of the case histories showed practically uniform absence of tenderness. It was also thought that the age of the tumor might be indicative of the physiological state of the patient, but no connection between the two could be made out.

So it became necessary to be content with the observation that although certain histological appearances quite regularly accompanied pregnancy they in themselves were no satisfactory evidence for or against its existence.

Mammary glands respond to a variety of growth stimuli. One occurs a few days after birth and manifests itself in the infantile secretion known as "witch's milk", another shows itself at puberty and causes the breast to grow to its adult proportions though sometimes it does not stop there, but continues until a massive size even as great as a weight of 60 pounds is reached.

The next stimuli result from pregnancy, when great parenchymatous activity shows itself in the preparation of lactation, and

here, again, instead of developing to the appropriate size for the performance of the function that is about to be exercised, the breast may grow to massive as well as useless proportions. But in addition to these well recognized stimuli, some cases seem to respond to unusual influences, as when the breast secretes at each catamenial period, or when milk appears in the virgin breast as the result of letting an infant suck at the nipples, or because of digital manipulation of the breast. Local glandular hypertrophy may also occur because of the presence of tumors or other pathological lesions in the neighborhood of the tissue so disturbed.

The tissue of the periductal fibromata seems to be susceptible to the same stimuli.

It may be because of the growth stimulus at puberty that so many of the tumors are referred to about that time, as the period of their first discovery. It may be because of frequent manipulation that some of them grow more rapidly than others. Pregnancy is accompanied by a great impetus to growth, and many tumors have been removed during its course because, though long known to have been present they suddenly began to grow. Several of the most interesting tumors in the present series were removed at the beginning of lactation because they grew to many times their original size in a day or two, evidently because they had begun to lactate, with no way of getting rid of the secretion that was distending their ducts.

Several authors, among them Ribbert, are quite emphatic in stating that periductal fibromata do not secrete when lactation is in progress. They frequently do not, but they may do so and excessively. All tumors do not equally receive the growth and secretory stimuli. Patients may pass through pregnancy and lactation with no change in small tumors in their breasts. Even when there are several tumors in the same breast, they may react differently, as is shown by the following case history.

Mrs F W., aged 28 years, white married had one young child and miscarried in July. In August of the same year she consulted her physician because a small tumor that had been present in her breast for a number of years had become larger and tender.

Later a surgeon was consulted, and she was advised that she might have a malignant tumor, and that the breast had better be removed. She accordingly went to a prominent hospital, and on October 28 of the same year 3 months after the miscarriage, the breast was amputated. She made an uneventful recovery and 6 years later died of peritonitis following appendicitis, having refused operation. There had been no return of the tumor, nor had she had any further trouble with the breast.

When the breast was examined in the laboratory of the hospital, it was found to contain 3 separate tumors, 1 about 3, 1 about 1½, and 1 about 1 centimeter in diameter. The smallest appeared to be much the same, but the largest was quite different in gross appearance. Upon microscopic examination the following histological structure was found:

1. The smallest tumor was a combination of intracanalicular and intercanalicular periductal fibroma. In the intracanalicular portions a few of the rounded polypoid eminences were distinct and typical, in other parts the parenchyma was hypertrophied to a considerable extent.

2. The next larger tumor contained no intracanalicular eminences at all, but consisted of a scanty stroma, in which the parenchyma varied. One half contained numerous ducts distended with what resembled colostrum corpuscles, the other contained so many and such closely packed ductules as to recall the "simple adenomata." Some of them were misshapen and crowded and had the epithelial cells so irregularly distributed that the pathologist suspected epithelial invasion, and feared "malignant disease."

3. The largest tumor was alveolar or racemose, its parenchyma so hypertrophied as to consist chiefly of mucus, and so actively secreting that, there being no outlets for the escape of the fluid, it was distending the ducts into cystic spaces, one very large cyst being filled with yellow creamy contents.

The different appearances presented by these tumors are interpreted as depending upon the differing degrees in which their tissues had responded to the growth stimuli, and participated in the lactation hypertrophy of the breast during the pregnancy that had terminated in the miscarriage 3 months previously.

## THE NON TUMOR GROUP—FIBRO ADENOMATA

Among the 289 cases studied there were 147 of the lesions declared not to be tumors. Of 94 patients the ages of whom were known, the average age was 37.7 years or nearly 10 years greater than the average age of the tumor cases.

The histological examination of the tissues removed from the breasts of these women showed nothing corresponding with the histology of any recognized tumor but always tissue in full correspondence with the structure of the breast itself. Not only was that true but the appearances in each case were in full correspondence with the age and physiological requirements for the individual concerned, so far as data upon such matters were available. That is to say, the tissues removed from young patients showed the fibrillar matrix and rudimentary lobules of youth; those from middle-aged patients the evidences of involution and abnormal involution seen ordinarily in the breasts of women of that age and condition; those from pregnant and parturient women the lactation hypertrophy expected. There was no doubt about the tissues being mammary gland tissue; the interest lay in the fact that they had been removed as tumors, regarded as such when grossly examined after operation and the diagnosis of tumor confirmed microscopically.

The clinical analysis of these cases showed the following: Of 83 patients with fairly definite clinical histories, every one was found to have presented herself to the surgeon because of the presence of a 'lump' in the breast. In 12 cases it was said to have 'become tender' or to 'cause trouble' or to 'get sore' or to be 'tender.' In 2 cases the pain is said to have coincided in time with the appearance of the menses. In 11 cases the lumps were 'painless,' 'insensitive' or gave 'no trouble.' In 5 cases the appearance of the lumps was attributed to antecedent traumatism. In 5 cases there had been previous operations for the removal of similar lumps.

The resident physicians in the various hospitals described the lesions as 'hard,' 'firm,' 'movable,' 'freely movable,' 'fibro-fatty,' and 'fibrocystic.'

In size the lesions were said to compare

with a goose egg, a grape fruit, an orange, a small orange, an apple, a hen's egg, a lemon, a lime, a plum, a walnut, a hickory nut, a pecan, a pigeon's egg, a marble, and a hazel nut. The size recorded by the first examiner did not always tally with that recorded by the later operator. In several cases the resident physician wrote that the breast of the patient contained 'a small hard tumor,' though the writer of the later notes added that a "large soft one" had been removed.

Although in nearly every case the first examiner noted that the lump was movable or freely movable, the surgeon rarely attributed that condition to 'encapsulation.' In only 6 out of 147 cases did the surgeon state that the tumor was encapsulated, and in only two others did he say 'well circumscribed.' In fact the descriptions given by the surgeons are interesting and are as follows: 'nodular mass' in 2 cases, 'cysts' in 7 cases, 'cystic' in 8 cases, 'fibrocystic' in 2 cases, 'fibrocystic tumors' in 6 cases, 'fibro adenomata' in 3 cases, 'fibro cystadenomata' in 7 cases, 'chronic cystic mastitis' in 7 cases, and in 35 cases it is stated that cysts large or small were present in the removed tissue.

It was hoped that the description of the operation might give some clue to the reason for regarding the removed tissue as from or a tumor but only vagueness was found. In 1 case the tissue was said to have been 'enucleated', in 1 it was 'enucleated with scissors', in 15 it was 'dissected out', in 25 it was 'excised', in 4 it was 'shelled out', in 18 it was 'removed', and in 1 it was 'cut away'.

The average pre operative duration of these lesions was 1 year, 9 months, 1 week, and 3 days, the extremes being 18 years on the one hand, and 3 days on the other. Lesions varying between such extremes can scarcely be the same.

One would suppose that the more leisurely examination of the tissue after their arrival at the laboratory ought to straighten out errors resulting from a hasty glance by the surgeon at the moment of operation but unfortunately it rather seemed to add to the confusion for as has already been pointed out, these tissues received no less than 33 different names, the

most popular of which were adenofibroma which was applied to 52, and fibro adenoma, which was applied to 17. In one large hospital sections of normal breast tissue received 9 different designations, though they looked almost exactly alike. How could such a circumstance have arisen?

Tissues from the clinic usually reach the laboratory accompanied by some kind of blank form bearing some kind of general or special information, varying in usefulness and thoroughness in different hospitals, but unfortunately, usually woefully lacking in the information that the pathologist should have in order that his talents and experience be afforded full opportunity for accurate diagnosis and prognosis.

The identification blank may state that the specimen is a tumor, or a piece of a tumor removed from the breast. This results in a false start. Whether the pathologist sees what appears to be tumor tissue or not, it is said to be such and he may feel no discretion in the matter. He therefore proceeds with the study of the tissue from the wrong standpoint, and begins the establishment of a vicious circle for having accepted the tissue as part of a tumor, he must find for it some appropriate name and, for example, decides upon "fibro adenoma." The surgeon, supposing that the pathologist knows, may be surprised to learn that he has removed a tumor, where only a cyst, for example, was supposed to have been. He recalls the chief gross features of the tissue, and when he sees it again, may not only call it a tumor, but give it the same name, with which it now reaches the laboratory, to be confirmed. Thus each supports and confirms as well as deceives the other until a tacit understanding arises that certain appearances shall be called by certain names, whether scientifically appropriate or not. But the confusion becomes worst when the system of false nomenclature reaches the extreme, as, for instance, when a breast removed because of suspected carcinoma, but in which no tumor could be found, was reported as "fibro adenoma," or when a small fragment of breast tissue adjacent to a cyst was called by the same name, although no tumor was suspected by the surgeon or found by the pathologist.

The reality of the situation cannot be better shown than by the finding of these 147 tissues all called tumors, not one of which was really a tumor and by the acknowledgment of the pathologists in whose collections they were found that they were not tumors but only breast tissue. They are convinced of the error but how long will it take to disabuse the minds of the surgeons of the misinformation they have received and satisfactorily explain the matter to them?

When the cases were discussed with the respective pathologists of the various hospitals in which the tissues were unearthed, in not a single case was the original diagnosis of tumor maintained after the obvious mistake had been pointed out.

But if the 'lumps' were not tumors how is their clinical tumor like quality to be accounted for? What were they?

It may not be possible to answer these questions satisfactorily because of the number of conditions that may occasion the occurrence of 'lumps.' In the first place it must be recalled that in 35 of the cases the presence of some kind of cysts is recorded. They are in themselves 'lumps,' but as they take up space at the expense of the mammary tissue proper, which is compressed and condensed by their presence, they suggest that other condensations may bring about similar indurations. For example, A young woman appeared with a "lump" in her breast. It was about a year since it had been discovered, and it seemed to be well circumscribed, firm, painless, insensitive and freely movable. Under local anesthesia the surgeon cut down upon it, and found a circumscribed and apparently encapsulated nodule that he removed with the greatest ease. He unhesitatingly made a diagnosis of "fibro adenoma," which was confirmed by microscopic examination at the hospital laboratory. Later however, when other sections were prepared an area of tuberculous disease was found to be situated at the center of the nodule, and the diagnosis was very properly corrected to "tuberculosis" of the breast.

That this lesion was first called "fibro adenoma" should not be overlooked. Eighteen out of 27 tissues from two hospitals, called by

that name were non tumors and only 6 were tumors—periductal fibromata. It is excellent evidence of the abuse of the name, for if fibro adenoma means periductal fibroma in 6 cases and nothing in 27 cases, it has no meaning at all and should be abandoned.

The other 'lumps' may not all be explained their causes were doubtless numerous and multifarious. One of 10 years duration may have been entirely different from another known to have existed for only a few days or weeks. An insensitive lesion may have had a different explanation from another that was sensitive or occasionally painful. Present inability to account for them indicates only how necessary it is for more careful studies of the breast lesions to be made and how important it is for the exploration of the breast itself to be complete.

#### THE INDETERMINATE GROUP

The patients from whom the tissues thus denominated were removed were women varying in age from 20 to 50 years the average being 31 years. Some were married some single. Plotting of the ages of 17 cases for which data was available gave no curve of age incidence. The cases distributed themselves in small numbers throughout the whole period of sexual life though none were very young.

If it had been possible to identify these tissues the group would not have been created some may have been tumors some probably were not. It was supposed that the lesions bore some relation to the evolutionary and involutional changes through which the mammary tissue passes in the course of its physiological activities. Histological appearances resembling these lesions were observed in some supposedly normal breasts and called fibromatoid involution.

But as the conditions were not identified they must at present remain unknown. Fortunately they in no manner influence the main facts and conclusions resulting from this research.

#### CONCLUSIONS

1 Two hundred and eighty nine cases supposed to be benign fibro epithelial tumors of the female breast, were studied clinically and pathologically for the purpose of harmonizing and simplifying the nomenclature.

2 One hundred and five of them described under no less than thirty three different names were found to be periductal fibromata.

3 One hundred and forty seven described under much the same names showed no histological indication of being tumors or in any way related to them but were simply mammary gland tissue either normal or in some condition of involution.

4 A system of nomenclature that permits tumors and non tumors to be given the same names is too faulty to be continued.

5 As all of the tumors resolved themselves into varieties of a single well characterized genus it would be well to call them all by the same name and that recommended as most appropriate is Warren's choice periductal fibroma.

6 In all but 37 cases there was no difficulty in separating the tumors from the non tumors.

7 The research having been conducted upon material collected from five large first class hospitals where it had been studied by many different pathologists may be regarded as fairly representative of pathological tissue work as commonly conducted in hospital.

8 The mistake of calling non tumor tissues by names belonging to tumors may have been the result of overzealousness on the part of the pathologists to co operate amicably with the surgeons.

9 There are anatomical and physiological mammary disturbances of the breast that may occasion lumps that have no relation to tumors and the surgeons should be so informed and not led to believe that they have removed tumors when none existed.

10 Pathology must remain confused both in theory and application unless its terminology be so relieved of ambiguity as to be easily understood.

# CHRONIC MENINGEAL (POST-TRAUMATIC) HLA DACHIL AND ITS SPECIFIC TREATMENT BY LUMBAR AIR INSUFFLATION, ENCEPHALOGRAPHY<sup>1</sup>

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**P**ATIENTS complaining of post traumatic headache and dizziness have been rather unwelcome patrons of most clinics. They have often received financial compensation and are living in hopes of a further settlement. These facts, together with the absence of abnormal physical signs, may lead to an unmerited diagnosis of traumatic neurosis.

It seems obvious that many of these patients suffer from a very real though poorly understood complaint and until a method of treatment was stumbled upon we had been in the habit in dispensary practice of separating out the patients whose complaints were unquestionably real, under the diagnosis of meningeal headache.

The first of these cases was treated in 1922 and although the cure was a complete one, the full significance of the result was not at that time realized, possibly because the procedure was undertaken from a diagnostic and not a therapeutic point of view.

As the result of my failure to interpret this first case correctly, no further attempt was made to relieve these sufferers of their headache until 4 years later. At about that time I discussed the matter with Dr. R. Wartenburg, who stated that he also had seen patients with headache relieved in the course of encephalographic studies.

Shortly after this conversation I saw the patient reported as Case 2. He was suffering from such excruciating headache that in March, 1927, lumbar air insufflation was undertaken in a frankly experimental effort to give him relief.

**CASE 1. A. L.** Post traumatic headache of 6 weeks duration.

Four weeks before admission to the hospital the patient, a boy of 4½ years, fell from a second story fire escape and received contusions of the occipital region. He was drowsy for 3 days. After the accident he had continuous frontal headaches and

was irritable. For a few days before admission the headache had become very severe and there was vomiting.

A linear fracture of the occipitoparietal region without depression was found by roentgenogram. Examination was otherwise negative.

**Lumbar insufflation.** (Spinal fluid clear, 6 cells, negative globulin, pressure with patient horizontal 200 millimeters of water.) By lumbar puncture about 50 cubic centimeters of spinal fluid was withdrawn and replaced by 47 cubic centimeters of air, the removal and replacement being made alternately in 5 cubic centimeter amounts. Roentgenograms (pneumograms) taken at once showed a considerable collection of air over the right frontal pole of the cerebral hemisphere in what seemed to be a circumscribed cyst. There were also a few bubbles in the intergyral sulci. On the following day the air was all in this location with none left in the sulci (Fig. 1). There seemed to be atrophy of the underlying lobe as indicated by the thickness of the air collection. Whether this cyst was in the subdural or the subarachnoid space, it is difficult to determine with certainty.

**Result.** For a few days he had some headache. After that time he was entirely free from it and there has been no recurrence in the 5 years which have elapsed since the insufflation.

**CASE 2. I. G.** Post traumatic headache and dizziness of 18 months' duration.

In January, 1927, the patient, an automobile mechanic of 47 years, came to the Presbyterian Hospital Dispensary, with the following story. Eighteen months previously, he had been struck by an automobile and taken unconscious to the Harlem Hospital where they made a diagnosis of fracture of the skull in the right temporoparietal region. His spinal fluid was found at that time to contain much blood, and the Harlem Hospital records show that he complained of diffuse headache most intense in the right occipital region during his 3 weeks of hospitalization. From that time on he suffered from headache for 18 months and went about in desperation from one clinic to another seeking help.

Careful questioning brought out the following features of his complaint. The pain was situated over the right eye and forehead. It seemed to be a pressure behind the eye and in addition there came sharp stabbing pain about every 5 minutes or at any time when he stooped over. This stabbing sensation would move quickly to the opposite side and then disappear. At night he sought relief by lying prone and resting his head on his left brow.

<sup>1</sup>Read before the Medical Society of the County of New York, October 24, 1927.

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Fig 3 Case 2 Brow up 24 hours after insufflation air in cyst

cortex or increased complexity of the subarachnoid channels for some other reason. Plates taken on the following day showed that the air outlining the sulci had disappeared, but there was a collection of air over the lateral aspect of the right frontal region with scattered bubbles about it. This collection remained here even in the plates taken with brow uppermost (Fig 3), showing that it was held in a cavity or partial cyst of some sort. There was no evidence of this cyst in the plates taken immediately after the insufflation and one wonders if it had not been opened up by the excursions of air which must have accompanied movements of his head during the first 24 hours.

**Result** Following the air injection he had a bad headache which was described as a feeling of pressure. This lasted an hour and a half. After this the headache disappeared and the following morning he felt much better and stated that he was able to sleep on his back instead of with face down for the first time in many months. During the following few days his headache disappeared altogether, both the dull ache in the right forehead and the sharp shooting pains. Moreover there was no more vertigo and no nausea.



Fig 4 Case 3 Left frontal headache. Brow up air in frontal subarachnoid spaces and a little in ventricle

He went in search of work at once and when seen 3 months after operation he was doing heavy work as a porter, his eyesight not permitting him to take up his former duties as mechanic. At present, 9 months after the air injection, there has been no return of his headache. Vertigo has returned however and is experienced particularly during long walks. Also, when he leans over forcibly to either side so that his head is carried rapidly to that side, he sometimes hears a curious sound, like rushing water as though one stood 'at the foot of a water fall'. The amount of air injected was small in this case and even though the headaches have not returned it is probable that a second insufflation will be undertaken shortly.

**CASE 3 J W** Post traumatic headache and dizziness of 6 months duration.

The patient was a stone mason of 34 years. Six months before admission to the hospital, a scaffolding fell and struck him on the top of the head. He was unconscious 2 or 3 minutes. On the following day he returned to work and continued at it for 3 weeks. But during this time he had almost continuous headache which grew progressively worse until he was forced to give up work.

About 4 days after the accident he began to be dizzy especially on rising from bed in the morning. This vertigo would come upon him, occasionally, at



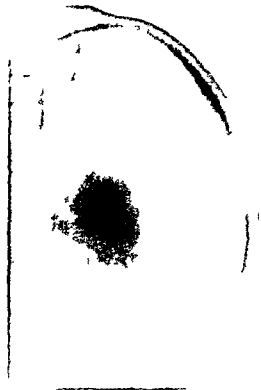


Fig. 3. Case 3. Blow up 48 hours after insufflation air probably in subdural space also in anterior horns of ventricle

other times so that he was afraid to mount the scaffolds where he was in the habit of working far above the pavements of New York.

The headache was dull in character and present in both frontal regions. It came on immediately after getting out of bed in the morning and disappeared about 11 or 12 o'clock to return for an hour in the late afternoon. It was made worse by coughing or blowing his nose. On several occasions blowing the nose produced clots of blood and once this was followed by a profuse discharge of clear fluid.

He was followed carefully and after several months had elapsed the headache seemed to lateralize to the left frontal region and was described as a hammering. After 6 months of this the headache had decreased somewhat and he tried to return to work for 3 weeks. He found, however, that vertigo made him fear a fall and that whenever he exerted himself as in lifting he experienced a very severe pain in his head. He complained also of increasing deafness.

Physical examination was essentially negative except for reduction in hearing and evidence of earlier otitis media.

**Lumbar insufflation.** The spinal fluid was clear horizontal pressure 150 millimeters of water. With the patient on his right side and the table tipped as

usual 95 cubic centimeters of fluid were removed in 5 cubic centimeter amounts and replaced with 84 cubic centimeters of air, keeping the fluid pressure about the same throughout. The left frontal region of the head was uppermost throughout the procedure. During the injection the patient complained of severe pain at first frontal and later in the neck.

The pneumograms first taken showed the well filled intercal spaces over the left hemisphere to be quite normal in appearance (Fig. 4). However the usual oscillations of the head designed to cause the air to pass to other portions of the subarachnoid space had that result to a limited extent only. Some of the air seemed to escape into the subdural space as it outlined the falx and appeared as a compact bubble over the right hemisphere.

Plates taken after 48 hours showed no more intercal air but a large bubble always present between brain and skull at its uppermost point (Fig. 5). There seemed to be some atrophy of at least one of the frontal poles as the air when it collected over this pole was of considerable thickness. It is difficult to be quite certain but this air seemed to be in the subdural space rather than in a subarachnoid cyst.

**Result.** He complained of headache for several days after insufflation particularly when he moved his head. On the ninth day however he was discharged entirely free from both headache and dizziness. Six weeks later he returned to say that he was still free from headache and that he was working on the fourteenth floor now where he could look directly down at the sidewalk beneath him. Even under these conditions he had felt no return of the vertigo.

**CASE 4. A. C. Post traumatic headache and dizziness of 2 months duration.**

The patient age 30 years was the wife of a doctor and had formerly been a trained nurse. She was referred by Dr. Walter Phillips of Englewood.

Two months before admission to the hospital she had been in an automobile accident receiving abrasions of the face. There was probably no concussion but from this time she complained of headache always localized in the left frontal region.

For the first 2 weeks which were spent in bed she was dizzy on raising her head from the pillow. After this vertigo was felt only occasionally and for no apparent reason. This did not cause her to stagger but she usually sat down until it passed. She occasionally experienced a feeling of being dazed and far away even while sitting quiet as for example at a game of cards.

The headache was described as pounding and like a weight. It always was located in the left frontal region. Occasionally she felt a sharp stabbing pain of very short duration in the top of her head. The headache though constant was made worse by stooping or fatigue and became regularly more intense in the late afternoon.

**Lumbar insufflation.** (The spinal fluid was clear horizontal pressure 180 millimeters of water. 3 cells

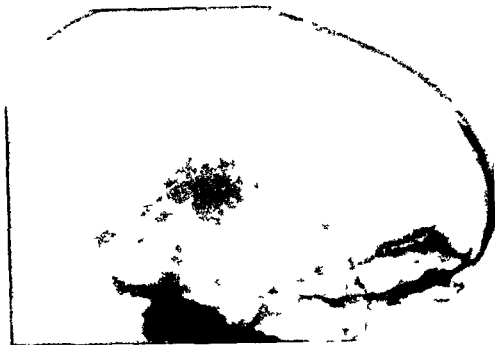


Fig. 6. Case 4. Right side of head up. Air seen in subarachnoid spaces and interpeduncular cistern.

normal globulin, total protein 23 milligrams per 100 cubic centimeters.)

In 5 cubic centimeter amounts 70 cubic centimeters of spinal fluid were replaced by an equal amount of air. There was renewed pain in the left frontal region with each injection of air, the patient being on her right side with head raised. During head oscillation this pain was felt in the right frontal region as well.

The pneumograms showed some widening of the subarachnoid fissures over the frontal lobes of both sides especially the left, suggesting slight atrophy (Fig. 6). Even the first day there may have been some escape into the subdural space (Fig. 7). But 2 days after insufflation the intergyral air had disappeared and was definitely collected in the subdural space being particularly easily seen over the frontal poles (compare Figs. 8 and 9).

**Result.** For 8 days following the insufflation the patient complained bitterly of pain which came on with each movement and was apt to be localized in the uppermost portion of the head. On the ninth day the headache disappeared for the first time since the accident and has not returned up to the present a period of 5 months. The vertigo likewise vanished completely, and she is in perfect health.

**CASE 5. M. F.** Headache and dizziness of 8 years duration.

The patient was a woman of 65 years who had been in an automobile accident 8 years previously and received a fracture of the skull and of one femur. The resultant unconsciousness lasted for 3 weeks after which she had difficulty with memory and some aphasia for several months. There was a laceration in the left frontal region and frontal head

ache and dizziness were severe for 2 years after the accident. At the end of that time a lumbar puncture was done. The headache became worse for 3 days and then almost disappeared. The dizziness was not affected.

During the past 6 years since the puncture she has complained of gradually increasing severe neuralgic pains in the frontal region usually on the left. This was associated with occasional dull frontal headaches which became almost continuous for several weeks before admission. Dizziness had also come to be almost constant and resulted in several falls.

The physical examination was negative except for paresis of left sixth cranial nerve.

**Lumbar insufflation.** Lumbar puncture which was performed by Dr. W. Cone showed a pressure of 200 millimeters of water. The fluid contained 11 cells, had a faintly positive globulin and negative Wassermann test and normal amounts of sugar, chlorides and protein. With the patient on her right side and the head of table elevated, 80 cubic centimeters of spinal fluid was replaced by air in 5 cubic centimeter amounts. There immediately resulted severe pain in the left frontal region with some vomiting.

The pneumograms showed very irregular wide subarachnoid intergyral sulci with a good deal of brain atrophy (Fig. 10), most marked in the vicinity of the left fissure of Sylvius. As the head was rotated into different positions and oscillated in each position air bubbles remained caught in the arachnoid sulci (Fig. 11) instead of passing freely to an uppermost position as is normally the case. It could be seen in the last plates to be taken on the day of the insufflation (i.e. in those taken after much movement of the



Fig. Case 4. Right side of head up. Air in subarachnoid and subdural spaces.

head) that much of the air had apparently escaped into the subdural space (Fig. 12). Two days later all of the air seemed to be in the subdural space (Fig. 13).

**Result.** The operation was immediately followed by cessation of the vertigo. The headache was increased for a few days and then disappeared completely. Three months later there had been no recurrence of the sharp head pain. At this time the vertigo was still remarkably improved, being experienced only on rising suddenly from a sitting position.

**CASE 6. P. C.** Post-traumatic headache and dizziness of 10 months' duration.

The patient is a carpenter of 32 years referred by Dr. H. Osserman. Ten months before admission to the hospital he was struck on the back of the head by a descending elevator. He was unconscious for 5 minutes. Next day he had generalized headache, most intense over the occipital region. He remained in bed most of the time for 5 weeks.

The headache continued steadily during the 10 months before his admission, although it grew somewhat less intense. It was situated over the occiput and radiated forward on the right to the parietal region. It was dull in character. There were never any sharp pains. The ache was worse in stormy or

hot weather. Occasionally he had a day free from headache. He was almost invariably awakened by the headache about 1 or 2 o'clock in the morning and was then in the habit of getting up to seek relief in smoking. He frequently could not get back to sleep at all after this.

During the first few weeks he experienced what he characterized as lightness in the head, each time he got up. At these times he thought he would faint. The sensation lasted from 2 or 3 to 10 minutes. Since that time the vertigo has most often come on when rising from his chair. On one occasion he had a bad fall when such a sensation came over him as he stood at the head of the stairs. He stated that when lightness of the head affected him while reading his vision was temporarily blurred.

**Spinal insufflation.** (Spinal fluid clear, 55 cells per cubic millimeter, globulin negative.)

Lumbar puncture was performed and 70 cubic centimeters of fluid replaced by an equal amount of air in 5 cubic centimeter amounts after the patient was placed on his left side on a slanted table. The patient's head was rotated so that the brow was down in order to cause filling of the cisterna magna and cerebellar arachnoid. He complained of pain first in the thorax, then in the back of the head and right ear. After 30 cubic centimeters of air had been injected the head was rotated so that the brow was slightly above the occiput. The pain then spread upward to the right parieto-occipital region following the movement of the air. When the head was oscillated for the purposes of roentgenography the pain left this region and was in general complained of at the uppermost portion of the head.

Pneumograms showed the subarachnoid space well filled and approximately normal in appearance. The cisterna magna was well outlined and air had entered the ventricle in considerably larger amount than is usually the case, doubtless due to rotating the face down at the beginning. On the second day the air was present in almost exactly the same amount in the ventricles but had vanished from the subarachnoid spaces including the cisterna magna.

**Result.** On the second day following the insufflation the patient remarked that he had slept through the night for the first time in 10 months. The old headache disappeared but he continued to have headache which moved about for 8 days. When he sat up the headache was at the top of his head. After 8 days most of which he was kept in bed he was discharged on the ninth day free of headache and dizziness.

**CASE 7. W. M.** Post-traumatic headache and dizziness of 1 month's duration.

The patient is a carpenter of 32 years who was struck in the left mastoid region 1 month before admission. He was not unconscious. He continued at his trade for a few days when he was advised to stop and be as quiet as possible. About the second day headache and dizziness began. The headache was bifrontal from the start and felt like a dull pressure. The vertigo was apt to come on suddenly and last only



Fig 8 Case 4 Brow up showing air in the subarachnoid spaces

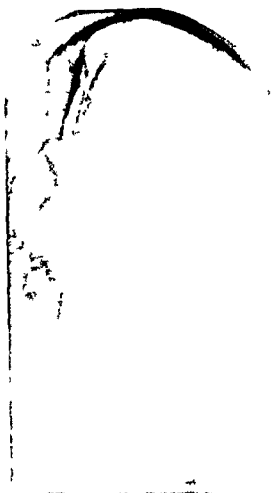


Fig 9 Case 4 Brow up 24 hours after insufflation air in subdural space

a few minutes. Occasionally he had the sensation of receiving a blow in the forehead with a hammer. The pain then seemed to spread back over his head subsiding gradually until the blow came suddenly again.

On examination he was found to have decreased hearing in the left ear, while bone conduction was louder than air on that side. There was fine nystagmus on gaze to the left. Otherwise examination was negative.

**Lumbar insufflation.** The pressure of spinal fluid when table was horizontal was 120 millimeter water cells, globulin negative.<sup>1</sup> With the patient on his left side his brow being rotated up and table inclined 75 cubic centimeters of fluid was replaced with 70 cubic centimeters of air in 5 cubic centimeter amounts.

At the close no more spinal fluid could be removed. He complained of generalized headache most severe in the frontal region. There was profuse diaphoresis and he vomited while he was on the table and several times during the head rotations for pneumography. The pulse fell to 50.

<sup>1</sup> Lumbar puncture 4 days later showed a pressure of 150 millimeters of water, 289 red cells, 6 lymphocytes and 3 polymorphs per cubic millimeter and faintly positive globulin.

**Result.** The patient continued to have headache after the insufflation. It was different in type and it moved about but it gradually subsided. He was kept most of the time in bed for 8 days so that the air might continue to move over the hemispheres. On the ninth day he was discharged feeling like a new man and free from headache. The vertigo which had come on two to three times a day before insufflation was not felt again afterward.

#### SUMMARY OF CASES

Seven cases of post-traumatic headache and dizziness have been presented. All of them have been relieved of their headaches completely although Cases 6 and 7 are too recent

<sup>1</sup> In addition to its use in selected cases as a diagnostic and lumbar insufflation has been undertaken by me for the specific purpose of relieving headache in only two additional cases not reported above. One of these gave symptoms similar to those of the post-traumatic cases but her headaches had followed a chronic mastoid infection and the relief although marked was not complete. The other case was that of an Italian who spoke such broken English that it was impossible to be certain whether or not his complaints fitted into the syndrome of meningeal headache. He stated that his pain was improved after the insufflation but complained still of backache. One could not be sure that his improvement was not due to suggestion and the whole case was so difficult of study that it is not included here.



Fig 10. Case 5. Frontal headache. Right side up 8 years standing. Air in subarachnoid spaces showing cyst formation and cerebral atrophy.

to permit a conclusion as to the permanency of their relief. All were enabled to resume their normal activity by day and to sleep soundly by night.

Of these 7 cases, each complained of some type of vertigo with the exception of the little boy (Case 1) who was probably unable to put the complaint into words, being only 4 years of age. Each of the 6 cases was relieved of his vertigo at once but in one patient (Case 2) occasional vertigo has returned. Only 50 cubic centimeters of air was used in this patient and a re-injection will probably be done.

The ages of the patients varied from 4 to 65 years. In each case the complaints dated from the time of a head injury which had occurred from 4 weeks to 8 years earlier. In 4 cases there was no loss of consciousness but in the others unconsciousness was of variable duration from 2 minutes to 3 weeks. In only 3 of the 7 cases could a fracture be proved. In 3 cases the site of the headache corresponded with the site of the blow. In 3 others the pain was frontal although the blow struck the occiput in one instance, the vertex in a second and the parietal region in the third.

The amount of air injected varied from 42 to 95 cubic centimeters. The immediate reactionary headache lasted from 3 or 4 up to 9 days after insufflation.

The pneumograms showed a cyst of the pia-arachnoid in three cases at least. There was frank escape of the air into the subdural space in three cases.

#### LUMBAR AIR INSUFFLATION

The technique as we have employed it differs somewhat from that of those who make use of it for encephalography only. In the first place we do the procedure in the operating room with complete aseptic precautions. The patient may be given  $\frac{1}{4}$  grain of morphine at the start and should receive more later if necessary, or scopolamine may be used with morphine (Strauss and Friedman).

If the location of the headache is right-sided place him on his left side on a horizontal table. Do a lumbar puncture and measure the spinal fluid pressure. Then tip the table so that the head is approximately 30 to 40 centimeters above the feet. If the headache is in the middle or anterior thirds of the head rotate the brow up about 45 degrees or less. In this position air passes directly to the fronto-parietal region via the basal cisterns very little entering the ventricles. If the brow be rotated sharply downward the cisterna magna may be filled and air usually enters the ventricles.

Withdraw fluid in 5 cubic centimeter amounts alternately injecting after each with



Fig. 11. Case 5. Brow up. Air in subarachnoid spaces and interpeduncular cistern.



Fig. 12. Case 5. Occiput up. Air in subarachnoid and in subdural space above and below tentorium.

drawal 5 cubic centimeters of air which is filtered through cotton. The whole system of tubing is connected by stopcocks in a closed system. Thus conditions are perfectly controlled and with a tight fitting syringe the amounts of air injected or fluid withdrawn can be controlled with ease.

About 100 cubic centimeters of air or less may be thus injected and it will completely fill the cerebral arachnoid spaces and basal cisterns. At the close the pressure should be about normal.

Without altering his position, the patient is sent to the X-ray room where horizontal and perpendicular plates are made in each headposition as by the usual routine (8). Thus the first two roentgenograms show air only over the convexity of the uppermost cerebral hemisphere. Before radiographing the head in each new position (i.e. occiput up, other side up and brow up) the head is os-

cillated thoroughly so that the air is carried through all parts of the subarachnoid space before the end of the procedure.

The patient should then remain flat in bed until the insufflation headache has entirely disappeared.

It has been our custom to raise the head of the bed on low shock blocks. In such a position each time the head is turned the air bubbles move over the hemispheres to the uppermost point as indicated often by the migrating local pain.

The side of the head where the headache was habitually most severe should be kept uppermost for the most part. If the patient be allowed to get up or sit erect, the air goes to the vertex and remains there moving little with head rotation. Therefore the erect position is prohibited for a few days after insufflation. With the absorption of the air the headache likewise disappears.



Fig. 13. Case 5. Right side up, air in subdural space outlining hemisphere and falx.

#### LITERATURE

Roentgenography of air which had been introduced into the cerebrospinal passages both by the ventricular and the lumbar route was first described by Dandy (4, 5) under the name of ventriculography. This procedure has come to be a most valuable diagnostic aid particularly for localizing cerebral tumors. Bingel (1) under the more completely descriptive term of encephalography was the first to use the method in Germany where lumbar air insufflation has been used very widely for more complete study of various types of affection of the central nervous system.

Thus air insufflation has been largely an aid to roentgenography. On the other hand, Foerster (6) when relating his experience with encephalography mentioned the two following cases in which there was a therapeutic effect.

Case 39 was suffering from left sided head aches following a blow on the head. Encephalography showed the ventricles pulled to the left, and he observed that the headache and dizziness did not return after the procedure.

Case 41 had had a severe blow on the side of the head after which there was a long period of unconsciousness. On recovery from the immediate effects of the blow the patient continued to have occasional attacks of transient hemiparesis and coma. These attacks were ushered in by headache, dizziness and evidences of increased intracranial pressure.

Encephalography showed unilateral enlargement of the ventricles and large patches of air over the cortex which it was believed indicated post-traumatic cystic arachnitis serosa. He advised operation but the patient felt so well after air injection that he refused.

Wartenburg (10) in 1926 described a case of coma secondary to subdural hematoma which seemed to be temporarily much improved by encephalography. He urged that encephalography may have a therapeutic effect on post-traumatic cases although he does not mention headache specifically but refers to the Case 41 of Foerster mentioned above.

Schwab (9) came very close to the subject of this communication when he read a paper



FIG. 14 Case 6 Right occipital headache Air in ventricle and subarachnoid space

on the "Encephalographic picture of the so called traumatic neuroses" before the society of German neurologists in 1925. He pointed out that in such cases air might demonstrate a variety of abnormalities of the ventricles and meningeal spaces. And it is interesting to note that in a few of his cases there was air over the surface of the cerebral hemispheres, which, to judge by the description, may have entered the subdural space.

In reporting 7 cases, Schwab stated that all complained of headache, dizziness, tenderness of skull, decrease in power of attention, general drowsiness and fatigue, sleep disturbance and at times intolerance to alcohol. But he mentions no therapeutic improvement. His encephalography was done in a different manner with the aim of filling the ventricles whereas we have made a point of completely filling the subarachnoid space. This and the after-treatment may perhaps account for the absence of therapeutic affect in his cases.

He maintained that arachnitis serosa accounted for most of the abnormal phenomena

of these patients and in the extended discussion which followed the paper it was generally agreed that arachnitis was the underlying pathology of the organic post traumatic disturbances. It was energetically pointed out by some of the discussers that Schwab's cases should not have been diagnosed traumatic neurosis even without encephalography. But throughout the discussion there is no mention of the fact that air insufflation may be used as a specific therapeutic agent for some if not all of the complaints which the patients under consideration presented.

On the other hand Carpenter (2) in 1926 pointed out that in a series of cases studied routinely by ventriculography (direct ventricular injection), 3 patients who were chronic sufferers from headache of an unknown nature were relieved of their pain. In the history of only one of these cases previous head injury was mentioned.

A year later Carpenter (3) reported 40 cases studied by encephalography (spinal injection). Twenty three of these proved to



have brain tumors Three cases of unexplained chronic headache were relieved after being so studied Again no relation to trauma is mentioned

Of these 3 cases the first was a woman of 24 who had suffered from headaches at intervals for 4 years and had been confined to her bed for 4 months She has been cured one year

The second case was that of a girl of 28 who had suffered from agonizing attacks of occipital pain and vertigo for 3 years There was also disturbance of vision ataxia and paræsthesia of the right side She was apparently relieved and returned to work after 2 months rest treatment

The third case of favorable result was in a woman who had suffered from headache for 17 years but she is apparently also included in the previous report (2)

Thus to sum up the literature Foerster has reported 2 cases of relief of headache in both of which the etiology was trauma although headache and dizziness were not the only symptoms In the 5 cases of Carpenter trauma was a factor in one and possibly in others as the histories are not complete Evidently neither worker has differentiated the type of headache which may be relieved In each case the improvement was incidental to diagnostic study

#### PATHOLOGY

Head trauma is the obvious cause of the syndrome in each of the reported cases and the development of headache does not seem to have been influenced very much by treatment as 4 out of the 7 spent from 2 to 4 weeks in bed after the accident

As was pointed out above there was pneumographic evidence of atrophy of the convolutions in some cases In 3 there was quite evident escape of air from the subarachnoid into the subdural space In two or perhaps three there was a definite subarachnoid cyst seen

The fact that a certain group of headache cases seems to be curable by a specific form of treatment singles these headaches out from all the others and makes it likely that they are caused by a common mechanism This

mechanism obviously has to do with an abnormality in the cerebral meninges Whether this abnormality may be an alteration in the normal circulation of cerebrospinal fluid caused by cysts or fine meningeal adhesions or whether the pain and vertigo have some other mechanical explanation will not be discussed in this communication

It has been held by Foerster and others that a cystic arachnitis serosa is responsible for such post traumatic symptoms as our patients gave<sup>1</sup> If that be true the air which often forms a bubble of large size must separate the filamentous adhesions of such a condition The abnormality whatever it is is obviously a mechanical one but it seems better for the moment to accumulate further data before venturing an explanation of the underlying pathology

#### SYNDROME

At present it is important to provide a description that will make possible the recognition of those cases susceptible of cure by air insufflation All headaches obviously can not be thus cured and the indiscriminate use of the method not only would cause unnecessary suffering but might well prove to be dangerous

Headache and dizziness may be taken as the cardinal symptoms The headache is invariably localized It may spread to a certain extent but it is definitely referred to one particular part of the head The location of the ache has most often been frontal but this seems to depend a good deal on the site of the trauma In most cases the pain was situated near the site of the blow with some tendency to radiate forward In one instance the headache was right frontal the blow being upon the occiput

The character of the headache is usually described as dull Three patients described it as hammering and a fourth seemed to feel the occasional impact of a hammer Three have complained of fleeting sharp pain at the site of the headache like the stab of a needle Ordinarily the pain is made worse by lifting blowing the nose or stooping although this is not invariable

<sup>1</sup>Ho as (?) has pointed out that in addition to the air in the meningeal process, he has signed as the use of a small device

The headache is usually present every day. It often has diurnal variations coming on shortly after rising from bed and reaching its apex in the latter part of the morning, some times becoming troublesome again in the late afternoon. In one case it became most troublesome after midnight. Some patients can not sleep because of it, while others are free from pain at night. Most of them are influenced unfavorably by stormy weather and some by hot weather.

The vertigo was present from the start in all but one instance where it appeared on the fourth day following the trauma. The sensation has been described often as "lightness in the head," once as a far away feeling. It lasts for several minutes without any sense of rotation. Moreover, the patients do not typically show nystagmus or other evidence of a vestibular lesion.

Vertigo may come on while patient is walking or on his rising from a chair or any time at all, so that the patients find it necessary to seize hold of something quickly and fear to go up on high places. This fear is justified by the fact that three patients have had bad falls.

In general there are no physical signs typical of meningeal headache. Two cases have shown some evidence of brain injury received at the time of the accident. At least 3 of the patients received skull fractures and all but 2 of them were unconscious for a variable period of time, immediately after the blow.

Finally, the diagnosis of meningeal headache may be made in the absence of abnormal physical signs when there is a history of

localized, dull, hammering headpain associated with transient attacks of vertigo, and all dating from a head injury.

To be sure the number of cases in the series is small and the follow up on some of them short. Nevertheless there is a striking similarity in the patient's complaints which seems to justify the recognition of these complaints as a syndrome. The uniform relief which lumbar or insufflation has afforded in all of the patients thus treated is gratifying testimony for the specificity of the treatment. Insufflation however must not be looked upon as free from danger and its indications and safeguards should receive careful consideration.

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MALIGNANT INTRACRANIAL ENDOTHELIOMATA<sup>1</sup>

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THE predominating types of intracranial neoplasms are gliomata and so called dural endotheliomata. The former have been analyzed by Cushing and Bailey with a view to establishing a gradation of relative malignancy, but the latter have long been considered clinically surgically and pathologically a relatively benign. However in a review of the cases in the Mayo Clinic several significant factors were noted which led to the impression that all such neoplasms are not benign but that a small percentage present the characteristics of malignancy.

MacCarty points out that few neoplasms are absolutely benign. All new growths regardless of the tissue involved are relatively malignant or at least possess malignant potentialities; an index to the relative malignancy rests with the cellular differentiation.

If the cells are fully differentiated into the special tissue which it is attempting to imitate the tumor is relatively benign. But if it contains undifferentiated cells it should be considered active and regarded with suspicion. The activity of a tumor does not in itself designate malignancy, but it signifies that it is growing and the degree of cellular activity indicates the rapidity of growth. Mitotic figures are also an index of the cellular growth. The three stages of activity are (1) hypertrophy of the cells, (2) hyperplasia or an increase of embryonic undifferentiated cells and (3) migration or invasion of the surrounding tissue by embryonic cells. These stages mark the metamorphosis of a benign into a malignant tumor. Thus a slow growing encapsulated neoplasm in which there is a preponderance of partially differentiated cells, few mitotic figures and a tendency to break through the surrounding capsule should be considered as relatively malignant.

It is generally believed that intracranial endotheliomata are encapsulated, that they compress but do not invade the brain and seldom metastasize. They do, however, fre-

quently invade the dura and overlying cranial bone and if the involved dura and skull are removed at operation the tumor will not recur. Such tumors are supposed to arise from nests of arachnoid cells and from cells accompanying the arachnoid villi which pierce the dura and project into the venous sinuses. Primary intradural endotheliomata are of two types: (1) a spherical or oval tumor embedded in the substance of the brain with variable attachment to the dura, and (2) endothelioma *en plaque* having broad attachments to the dura and producing only slight indentation of the surface of the brain. Cranial hyperostosis or hemi-craniosis occurs frequently with intracranial endothelioma. Cushing believes that this occurs in tumors of the frontal and temporal regions particularly if they originate near the falx. He also believes that the second type endothelioma *en plaque* is more likely to produce this condition. He found endotheliomatous invasion of the thickened bone and believed this thickening to be due to the stimulating effect of the invading tumor. Penfield describes two types of cranial hyperostosis: a thickening and a local erosion. Localized bony thickening was present in 75 per cent of Cushing's series of 80 cases of meningeal endothelioma. Penfield, in reporting 10 cases of cranial and intracranial endothelioma in which hemi-craniosis was associated, stated that whatever the etiology of these tumors the cranial prominence is secondary to the invasion of the skull by the intracranial tumor. He also stated that neoplasms of this type do not show a tendency to local recurrence after their removal even though the scalp and muscle are invaded nor do they manifest a tendency to form a fungus if they are only incompletely removed.

The histological nature of intracranial neoplasms has been investigated for many years because they were first classified with the heterogeneous indeterminate group of endotheliomata if they could not be definitely

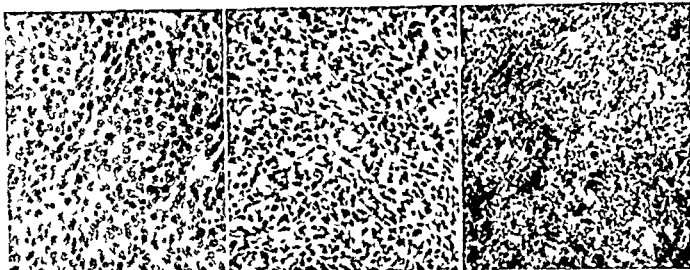


Fig 1

Fig 2

Fig 3

Fig 1 Case 1 Many multinucleated cells are shown undifferentiated and not conforming to any regularity of structure a few embryonic cells with large single nuclei, and many mitotic figures scattered throughout Malignancy is graded 4

Fig 2 Case 3 Cellular neoplasm showing undifferentiated cells of varying size and not conforming to any

regularity of structure Mitotic figures are scattered throughout Malignancy is graded 3

Fig 3 Case 5 Cellular neoplasm containing embryonic cells of varying size and nuclei of varying character Few mitotic figures are present There is no regularity of structure but some attempt at differentiation Malignancy is graded 2

separated structurally into epithelial and connective tissue growths This large group has been gradually reduced by the more definite classification of many of them Originally such tumors were supposed to arise also from the endothelial layer which lines the dura This has been proved fallacious, and the origin has been definitely attributed to the arachnoid either alone or in combination with the pia

To those of us who are attempting to classify and name these intracranial tumors satisfactorily, the situation is further complicated Mallory, from the standpoint of connective tissue structure, has called them "arachnoid fibroblastomata" Cushing, assuming that they arise from the meningioblasts, has called them "meningioma" In accordance with these views, Oberling has advanced the hypothesis that the leptomeninges are formed from meningioblasts, arranged in an extensive syncytium extending between the nervous parenchyma and the dura, and that the meningioblasts take their origin from the neuroglia This would lead to the assumption that the tumors are derived from the leptomeninges and fundamentally from the neural tube which is ectodermal in origin In further justification of this view, Learmonth quotes Harvey and

Burr as having recently conducted some convincing experimental work on the basis that these tumors arise from the arachnoid, which is epiblastic

Thus it appears that the term endothelioma is a misnomer and should not be used However, for purposes of convenience and to avoid difficulties of interpretation, I shall adhere to this term

A review of the gross and microscopic pathology in the Mayo Clinic series of 56 cases of intracranial endothelioma revealed two significant facts first that a definite small group of cases were set apart from the usual picture of benign encapsulated tumors, second, that they showed cellular activity with areas of embryonic undifferentiated cells and mitotic figures Some of them also showed invasion and a breaking through of the surrounding capsule not only into the skull and scalp but also into the underlying brain cortex Associated with the pathological picture was the clinical history of a rapid increase in the severity of symptoms, hence the assumption that these neoplasms are malignant Originally the tumors may have presented the classical picture of benignity, and yet at operation have proved to be malignant both grossly and microscopically



Fig 4

Fig 4 Case 6 Cellular growing neoplasm showing an attempt to form whorls. The cells are partially differentiated and there are few mitotic figures. Grade 1.

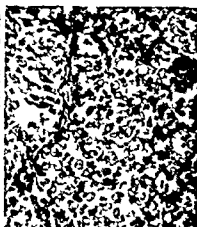


Fig 5

Fig 5 Case 7 Many undifferentiated cells with deeply



Fig 6

staining nuclei and many mitotic figures are shown. Malignancy is graded 4.

Fig 6 Case 10 Cellular tumor with undifferentiated cells and many mitotic figures. Malignancy is graded 4.

#### ILLUSTRATIVE CASES

**CASE 1** A man aged 40 came to the Mayo Clinic complaining of numbness and weakness of the extremities on the right side which he had noticed about a month previously. Coincidentally with this his vision failed. He also complained of a lump over the posterior parietal area on the left side of the head which had been present for a number of years and had recently increased in size.

Examination revealed weakness of the entire right side of the body. Urine and blood were normal. The Wassermann reaction was negative. A decrease in vision, bilateral choked disk of 3 to 4 diopters and right homonymous hemianopsia were noted. Roentgenograms of the head showed marked thickening of the posterior parietal area on the left. Neurological examination showed slight weakness of the right side of the face and decrease in speed, tone and strength of the extremities on the right side. There was definite incoordination with mild ataxic gait and tremor on the right side. A diagnosis was made of parasagittal endothelioma of the left parietal area and exploration advised.

A skin flap was dissected from over the osteoma and the endothelioma while the overlying bone which it had invaded was resected. It was necessary to resect the longitudinal sinus and to remove a portion of the falx. The capsule disclosed numerous invasions and extensions into the surrounding brain cortex. The tumor was very cellular (graded 4) and through it were scattered many mitotic figures. The cells were embryonic and undifferentiated some containing large deeply staining nuclei and others multinucleated (Fig 1).

**CASE 2** A man aged 30 came to the Clinic complaining of headaches which had persisted for a year. One month previous to the onset of the headaches he had received a severe blow over the left

frontal area in a railroad wreck. The headaches, which were associated with blurring of vision, occurred every 3 or 4 days coming on in the early morning while the patient was in bed. The symptoms were increasing in severity. There was no nausea or vomiting. For 3 months previous to his examination he had gradually become dull and apathetic. About a week previously a lump had appeared over the left frontal region.

Examination did not reveal outstanding abnormalities except a small pulsating tumor over the left frontal area. The urine was normal. The hemoglobin was 13 per cent, leucocytes numbered 10,000 and erythrocytes 4,910,000. The blood and spinal fluid Wassermann reactions were negative and the cell count of the spinal fluid showed the presence of 3 small lymphocytes. Vision in the right eye was 6/0 and in the left 6/50. The right pupil was larger than the left. Examination of the fundi showed a choked disk of 2 diopters. Roentgenogram of the head showed marked erosion of the left frontal bone. The results of the neurological examination were practically negative except for bilateral decreased patellar reflexes. In view of the soft tumor in the left frontal region, the change in personality and the choked disk, a diagnosis was made of endothelioma and exploration advised.

The tumor proved to be a malignant endothelioma which had eroded the skull. It was definitely encapsulated and projected into the left frontal lobe. Many dural metastatic nodules were noted. The cellular tumor (graded 3) contained cells of various sizes and many mitotic figures. It was growing rapidly and although encapsulated would have broken through before long as evidenced by the metastasis or implants.

**CASE 3** A man aged 22 had noted diplopia and failing vision for the previous 3 weeks. For 2 years,



Fig 7 Case 3 Encapsulated surgically benign tumor which was completely removed. It is definitely malignant (Fig 6)



Fig 8 Case 4 Encapsulated tumor which had broken through its capsule and was removed in three stages. Malignancy is graded 3.

at infrequent intervals he had had spells of unconsciousness. The urine and blood were normal. The Wassermann reaction was negative. Examination of the fundi disclosed bilateral choked disk of 3 diopters and left homonymous notching for colors in the upper quadrant. Roentgenograms of the head were negative. Neurological examination showed the presence of horizontal nystagmus and palsy of the right external rectus. A diagnosis was made of brain tumor of the right temporoparietal region and exploration was advised.

Through a right temporoparietal exploration an endothelioma was located under the right temporal lobe pushing the occipital lobe toward the median line. The tumor was covered with animal membrane and the wound was closed. Ten days later a unilateral occipital flap was turned in conjunction with the previous flap and the tumor was found to arise from the right lateral sinus. It was definitely encapsulated and had not invaded or broken through the capsule and was easily enucleated after resection of the lateral sinus and a portion of the tentorium cerebelli (Fig 7). The tumor was active and cellular with cells of varying size. The nuclei also varied in size but were deeply staining. Mitotic figures were seen throughout. Structurally the tumor did not adhere to form and the cells were undifferentiated. It was highly malignant (graded 3) and rapidly growing and would soon have broken through the capsule and invaded the surrounding structure (Fig 2).

CASE 4 A man, aged 25 complained of dull throbbing headaches which had begun about 6 months previously. They occurred every week or 10 days coming on in the early morning. He had also had transient attacks of diplopia.

The urine and blood were normal. The blood Wassermann reaction was negative. Vision was normal but acute bilateral choked disk of 3 diopters and right homonymous hemianopsia were noted. Roentgenograms of the head were negative. Neu-

rological examination was negative except for slight aphasia and slight facial weakness on the right side. Because of the hemianopsia, facial weakness and mild aphasia a diagnosis was made of brain tumor in the left temporal area and exploration was advised.

A large osteoplastic flap was turned down over the left temporoparietal area revealing endothelioma at the juncture of the lateral and sigmoid sinuses. There was moderate bleeding and since the tumor was large it was decided to remove it at a second stage. Ten days later a cerebellar flap was turned in conjunction with the temporoparietal flap. The tumor was very large and vascular and about three-fourths of it was removed with electric cautery. Transfusion was given at this time and the wound was packed and closed. Ten days later the wound was reopened and after the sigmoid and lateral sinuses had been ligated the remainder of the tumor was removed. The tumor (graded 3) was very cellular the cells varying in size and in staining, propensities undifferentiated and without systematic arrangement. Undoubtedly the tumor was malignant since it had broken through the capsule in several places (Fig 8). The short history testifies to the rapid growth.

CASE 5 A woman aged 43 came for examination because of failing vision, weakness and headache. The headaches had begun about 3 years previously. They were confined to the occipital region and lasted from a minute to an hour. Gradually they became more severe and one year previously nausea, vomiting and failing vision developed. Mental dullness and numbness and tingling of the left leg were noted at about this time. This increased until the entire left side was markedly weakened and there was a Parkinson's tremor of the right hand.

The urine and blood were normal. The blood Wassermann reaction was negative. Vision in the right eye was 3/60 and in the left eye light perception. Fields showed concentric contraction and the fundi secondary optic atrophy. Roentgenograms



Fig 9 Case 6 Encapsulated nodular tumor which was completely removed. It had not broken through its capsule but microscopically it is malignant (Fig 4)



Fig 10 Case 8 Encapsulated neoplasm which had invaded the overlying bone and broken through into the underlying brain. Malignancy is graded 2

were negative. Neurological examination showed diminution in speed and strength of the levator scapuli muscle and diminution in speed and tonus of the gluteus maximus muscle on the right side. On the left side there was diminution in strength of the interossei muscles and the gluteus maximus muscle. The biceps reflex was increased on both sides as were the supinator reflexes. Bilateral Hoffmann and Chaddock signs were present and the patellar and Achilles reflexes were increased. There was definite incoordination and the gait was slightly spastic on the left side. A diagnosis was made of parasagittal endothelioma and exploration advised.

The removal of the tumor was completed at a second stage operation 10 days after the first stage. The tumor arose from the longitudinal sinus with the greater portion on the right side but extending into the left. It was more or less encapsulated and rather soft. A large portion of the longitudinal sinus as well as a portion of the falx cerebri was included in the resection. The tumor had broken through the capsule and had invaded the brain in several areas. The microscopic picture was that of a fairly well differentiated cellular neoplasm (graded 2) with few mitotic figures (Fig 3).

CASE 6. A man aged 57 came to the Clinic complaining of headache, dizzy spells and loss of memory. The headaches had begun about a year previously and had been increasing in severity until 3 months prior to his visit when he was awakened by them every morning.

Urine and blood were normal. The blood Wassermann reaction was negative. Vision was normal.

Bilateral choked disks of 3 diopters were present and the fields showed concentric contraction for form and colors. Roentgenograms of the head were negative. Neurological examination disclosed some lack of co-operation and mental dullness with slight weakness of the left side. A diagnosis was made of brain tumor in the right frontal motor area and exploration advised.

An osteoplastic flap was turned down over the right frontal motor area revealing a tumor adherent to the dura nearly opposite the middle and superior frontal convolutions and pressing backward on the motor area. The tumor was encapsulated, densely adherent and very vascular. It was removed after ligation of the longitudinal sinus at a second operation a week later. It measured 8 by 7 by 6 centimeters and weighed 155 grams (Fig 9). The growth was very cellular and active. The cells conformed to an irregular structure and there was an attempt to form whorls. Only a few mitotic figures were seen. Malignancy was graded 1 (Fig 4).

CASE 7. A woman aged 35 complained of dizziness and headache of 18 months duration at first they came on in the morning about once a week but for 3 weeks they had occurred daily. The patient had become drowsy and stuporous and the gait somewhat uncertain. A tumor in the left frontotemporal region had been present for about 6 years. It had increased in size very slowly but in the previous 3 weeks after the birth of a child it had grown decidedly larger.

A specimen of urine contained a few red blood cells and pus cells and the blood urea was 16 milligrams

The hæmoglobin was 72 per cent, the erythrocytes numbered 4,220,000 and the leucocytes 10,000. The blood Wassermann reaction was negative. The eyes were normal. Roentgenograms of the head showed a large osteoma in the left temporoparietal area. Neurological examination revealed a dull stuporous person with aphasia, incapable of co-operation. There was decided perseveration. A diagnosis was made of endothelioma, and exploration was advised.

At operation the osteoplastic flap including the osteoma was elevated with difficulty. The large endothelioma was infiltrating the brain and spreading out under the dura. The tumor was cellular, the cells varied in size but were undifferentiated. The nuclei also varied in size and staining propensities. Many mitotic figures were scattered throughout. Malignancy was graded 4 (Fig. 5).

CASE 8. A woman, aged 43, complained of headache of 10 years' duration, and of loss of memory and blurring vision for the previous 6 months. For 7 months she had noted numbness and tingling over the left arm and leg. She was nauseated and vomited at rare intervals during the intense headache.

Examination revealed slight exostosis over the right parietal area. Pus in the urine was graded 1 with 20 cells to the field. The blood urea was 30 milligrams. The blood was cytologically normal. The blood Wassermann reaction was negative. Roentgenogram of the head showed marked intracranial pressure. Vision was normal, there was concentric contraction for form and colors, and slight blurring of both disks. Neurological examination showed bilateral reduction of the reflexes of both lower extremities, slight incoordination, especially on the left side, ataxic gait, and bilateral positive Romberg sign. A diagnosis was made of brain tumor in the right parietal region and exploration was advised.

Exploratory craniotomy was performed on the right parietal area and a malignant endothelioma was found. The tumor was definitely encapsulated except in the posterior part where it had penetrated the capsule into the underlying brain. The bone was involved and the tumor with the attached dura and bone was removed (Fig. 10). The tumor was very cellular (graded 2). The cells varied in size and did not conform to type structurally. A few mitotic figures could be seen throughout.

CASE 9. A woman, aged 55, complained of headache and vomiting associated with character change and loss of memory of 18 months' duration. The headaches were mainly in the right frontotemporal area.

The urine contained pus, graded 1, with 6 cells to the field. Leucocytes numbered 6,800. The blood and spinal fluid Wassermann reactions were negative. The fundi showed bilateral choked disks of 1 diopter. The neurological examination was negative except for diminution of speed in the left hand and positive Rossolimo and Mendel Bechterew signs on the left. A diagnosis was made of right frontomotor lesion and exploration advised.

An osteoplastic flap was turned down over the right frontoparietal region and a large encapsulated brain tumor attached to the dura was found extending mesially and anteriorly to the frontal lobe. The tumor appeared to be about 10 centimeters in diameter and was too large to remove without turning the flap forward. This was done 5 days later and the tumor was removed. The tumor was encapsulated but had broken through in several places. It was cellular, the cells were partially differentiated and many mitotic figures could be seen throughout. Malignancy was graded 3.

CASE 10. A man, aged 34, came for examination because of headache, general malaise and left-sided paralysis. Two years previously he had been struck on the head and 4 months previously he had noticed a lump over the right parietal area. The headaches had come on 3 weeks before his registration and occurred early each morning. One week after their onset he had noticed paralysis of the left hand and arm.

The urine and blood were normal. The blood Wassermann reaction and the roentgenograms of the head were negative. Examination of the fundi revealed bilateral choked disks of 3 diopters with hemorrhage and exudate. The ocular movements were slow with poor elevation and questionable conjugate weakness to the left. Neurological examination showed decrease in strength and in speed of both left extremities. There was definite incoordination on the left side. A diagnosis was made of brain tumor of the right parietal region and exploration was advised.

A large osteoplastic flap was turned down over the right parietal area and an infiltrating tumor, evidently arising from the dura and eroding and invading the bone was revealed (Fig. 11). The tumor was about 9 centimeters in diameter and 5 centimeters thick, with numerous extensions along the dura. The entire bone flap and all of the dura of the exposed field were removed. As much of the tumor as presented was removed, it being necessary to resect part of the longitudinal sinus. However, there still remained a flat portion of the tumor around the edge of the dura and the brain underneath was flattened and slightly degenerated (Fig. 12). The endothelium was highly malignant (graded 4) and had involved the dura and bone. At necropsy, multiple metastatic areas in the dura and implantations on the arachnoid were noted. This was a typical diffuse type of neoplasm *en plaque*. The tumor was cellular with undifferentiated cells and mitotic figures throughout (Fig. 6).

CASE 11. A man, aged 52, complained of headache and vomiting which had persisted for 3 months. He also complained of having had diplopia and blurring vision for the previous 5 weeks. The headaches, which occurred in the morning, had been continuous for the previous 5 weeks.

The systolic blood pressure was 84 and the diastolic 66. The urine contained pus, graded 1 with 5 cells to the field. The blood urea was 44 milligrams for each 100 cubic centimeters. The hæmo-



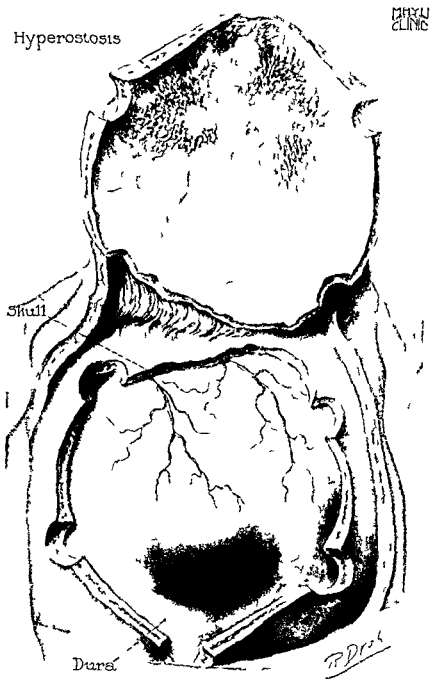


Fig. 11 Case 10 Malignant endothelioma as it appeared on elevating the bone flap

globin was 8.3 per cent the erythrocytes numbered 4 600 000 and the leucocytes 5 800. The blood Wassermann reaction was negative. The fundi showed a choked disk of 3 diopters on the left the right was normal. The roentgenograms of the head

were negative. Neurological examination showed horizontal nystagmus and adiadochokinesia +3 on the left. There was tinnitus in the left ear and partial nerve deafness. A diagnosis was made of cerebellar tumor and exploration was advised.

Bilateral cerebellar exploration and decompression was performed and an encapsulated tumor of the left cerebellar fossa was found. The tumor was very vascular, and a second stage operation was decided on. At operation 10 days later, when the tumor was enucleated it was found to arise primarily from the arachnoid and dura on the posterior inferior surface of the cerebellar lobe. It was encapsulated and had not broken through and invaded the surrounding brain tissue. The tumor (graded 3) was cellular and partially differentiated with mitotic figures scattered throughout.

A review of the histories of these cases, and a comparison of the microscopic appearance of the neoplasms, showed that in Cases 1, 3, 4, 10, and 11, the onset of symptoms occurred less than 6 months before the tumor became evident and the degree of cellular activity was found to be correspondingly pronounced. In Cases 1, 4, and 10, the tumor had broken through the capsule and invaded the underlying brain. Although the tumors in Cases 3 and 11 were completely surrounded with their capsules, yet early removal (6 weeks and 3 months, respectively, after the onset of symptoms) would account for the evident discrepancy.

In Cases 2, 5, 6, 7, 8, and 9, the patients gave a history of having had symptoms for from 1 to 3 years, and yet at the time element is carefully analyzed, it is apparent that the severity of the symptoms increased shortly before the patients' registration. This is most clearly shown in Case 7, in which symptoms had begun with headaches 18 months previously. The patient had a large osteoma which she thought had existed for 6 years. Following the birth of her baby 3 weeks before admission, the osteoma increased in size and the intracranial symptoms became more severe. This is in accord with the conception of the influence of pregnancy on neoplasms elsewhere in the body. With regard to the cellular activity as seen microscopically, the malignancy in this group as a whole was not as severe as in the first group. In fact comparison seemed to show that the neoplasms that had existed longer were originally benign and that a malignant change had caused increased severity of the symptoms. This is evidenced by areas throughout the tumor which approach the benign in structure with the characteristic whorls and psammomata.

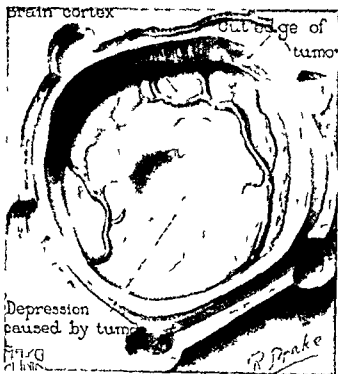


Fig. 12. Case 10. Malignant endothelioma *en plaque* showing the cut edge of the tumor and the depression of the cortex.

Broders grades malignant epitheliomatous neoplasms on the cytological picture of the relative differentiation of the cells. He has observed that epitheliomata that have produced the so-called epithelial pearls are of a low degree of malignancy. In other words, the tumors of low malignancy show a greater degree of differentiation and tend to form whorl-like areas of keratinized epithelium. The more malignant types of the neoplasm do not tend to develop such whorls. Since these dural endotheliomata arise from the ectodermal layer and show characteristics similar to the epitheliomata, why is it not plausible to apply to them the same method of grading?

A review of the 56 cases of intracranial endotheliomata in this series demonstrates that the tumors present a definite structure under the microscope, characterized by whorls of long, flat cells with small nuclei and the formation of psammoma bodies. This is true only of the benign or inactive tumors, when these are compared with the 11 malignant neoplasms a marked difference in the cytological picture can be seen.

In these malignant types of endothelioma, a psammoma body is rarely seen and then it is

associated with marked differentiation of the cells and absence of mitosis which stamps the malignancy as of low grade. Also when the whorl like structure is seen the differentiation of the cells is fairly complete and it is difficult to find the mitotic figures. The malignancy of these neoplasms is also of a low grade. However in the more malignant types the cells are but slightly differentiated without structural formation and with many mitotic figures. Consequently the 11 malignant endotheliomata recorded here have been graded according to Broders' classification of epitheliomata. After gradation of the tumors with regard to cellular differentiation, mitosis, and structure the histories were reviewed in order to see if the comparison also followed Broders' classification. It was found that the tumors that presented the highest degree of malignancy microscopically (grades 3 and 4) were rapid in onset and short in duration, and that those with a higher degree of differentiation fewer mitotic figures and more regularity of structure (grades 1 and 2) had existed longer and were insidious in onset.

#### CONCLUSIONS

1 Intracranial endotheliomata are not always benign. A small percentage are malignant and the relative malignancy is judged by the amount of cellular differentiation and mitosis and the tendency of the cells to arrange themselves in regular formation. The malignancy is graded from 1 to 4.

2 Tumors graded 1 are the least malignant and are characterized by more complete differentiation of the cells, fewer mitotic figures and more distinct tendency to form whorls and psammoma bodies. In tumors graded 2 and 3 the microscopic picture becomes more cellular and less regular as regards structure, and mitosis is more common. The most malignant tumor (graded 4) is not regular structur-

ally, the cells being undifferentiated and mitotic figures being scattered throughout.

3 From the surgical standpoint, these malignant endotheliomata, if they have not invaded surrounding structures, are comparable to such malignant tumors elsewhere in the body, and if they are completely removed a definite cure is effected. However, if they have broken through their capsule and have invaded the surrounding tissues the grade of malignancy indicates the likelihood of recurrence and if they are incompletely removed the grade of malignancy indicates the time element involved in this recurrence. Furthermore, the endotheliomata of short duration with rapid progression of symptoms indicate early and complete removal since in all probability they will prove microscopically malignant in grades 3 or 4.

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## THE PREVENTION OF PERITONEAL ADHESIONS AND ENCAPSULATION

PRELIMINARY REPORT OF AN EXPERIMENTAL STUDY OF PERITONEAL REACTION TO HYPERTONIC DEXTROSE SOLUTION<sup>1</sup>

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**I**N the voluminous literature that has originated in the experimental and clinical study of the peritoneum, two basic facts have received universal acceptance:

1. No foreign body, whether fluid or solid, however bland or non-irritating or sterile, can be placed in contact with the peritoneum without producing prompt partial or complete encapsulation by adjacent loops of bowel and omentum.

2. No method has been developed whereby adhesions between contiguous inflamed loops of bowel and omentum can be prevented.

Yates (5) is largely responsible for the present day attitude on the subject of peritoneal drainage. His conclusions may be quoted to advantage herewith:

1. Relative encapsulation of the drain is immediate.

2. Absolute encapsulation occurs in less than 6 hours; this can be retarded but not prevented.

3. Adhesions under approximately normal conditions form about any foreign body.

4. Their extent and density depend upon the degree and duration of the irritation of the body.

5. Primarily fibrinous, these adhesions become organized in a few days (3 days in dogs).

6. Irrigation through the drain is futile to prevent adhesions and dangerous.

7. Peritonitis, if not too severe, possibly aids in the rapidity of the encapsulation of the drain.

Since 1905, a vast amount of experimental effort has been expended in the attempt to find a substance that would prevent adhesions, or a drain that would defy this inevitable encapsulation. Petrolatum, the various paraffine oils, olive oil, egg albumin, milk, peptonized milk, Ringer's solution, ammonium oxalate,

sodium citrate, all have failed to accomplish this end. Such bland substances as the oils not only fail to prevent fibrin formation but actually produce adhesions of a density not commonly seen after a bacterial peritonitis.

Adhesions and encapsulation begin with the precipitation of fibrin on the peritoneal surface. The amount of fibrin varies within wide limits in the presence of inflammation, occasionally being entirely absent in cases of virulent rapidly spreading peritonitis. Under approximately identical conditions there is an individual variation in the amount of fibrin formation that cannot be explained. We have noted this variation in our experimental animals. In the presence, however, of a serous transudate of massive proportions under the identical degrees of irritation produced by rubber drains and tincture of iodine solution, we have been able to prevent fibrin formation with the accompanying encapsulation and adhesions over a period ranging up to 72 hours. We used a 20 per cent dextrose solution to produce such a transudate.

When a hypertonic solution is placed in contact with the peritoneum, the resultant osmotic tension promptly produces a transudate proportional to the amount and strength of the solution. A considerable amount of experimental work has been devoted to the use of sodium chloride in peritonitis. Very little has been done with dextrose. Kuhn (2) in 1911 first suggested the substitution of sugar solution for salt solution in the treatment of this disease. He also called attention to the fibrinolytic action of sugar and suggested the possibility thereby of improving drainage. He did not, however, carry out his idea in any experimental work with drains. Reschke (4) 10 years later, finding little work checking up that of Kuhn, studied the effect of hypertonic solutions on peritoneal resorption with a view



Fig 1 (left) Control experiment illustrating the typical reaction of the normal peritoneum to a sterile foreign body. The rubber tube is completely encapsulated (24 hours)



Fig 2 Complete absence of fibrin and freedom from encapsulation at end of 24 hours resulting from use of hypertonic dextrose solution. This tube extended from the upper abdomen to the pelvis

to using such solutions in peritonitis. Reschke could not verify the fibrinolytic action suggested by Kuhn, but concluded that the chief value in the use of dextrose was in the delay in resorption of the exudate in peritonitis.

#### EXPERIMENTAL WORK

The first phase of the work consisted in the study of the reaction of the peritoneum to rubber drains in the presence of dextrose solution. The concentration of the latter was 20 per cent. Two types of tubing were used: a soft tubing of the consistency of dental dam and ordinary soft red and black tubing with a diameter of 5 millimeters. The tubing was introduced through a short rectus incision; the entire tubing being in the peritoneum, none of it being allowed to project. In our earlier experiments the tube was allowed to project through the abdominal wall in the usual manner of abdominal drainage, but this had to be abandoned because in a dog a water tight junction cannot be made and even with the tube tightly clamped leakage along the side of the tube occurred.

Immediately following closure of the abdomen dextrose solution was injected hypodermically just below the right costal border. In one hour the volume of fluid is almost doubled. Narat (3) studying the action of dextrose in rabbits found that 50 cubic centimeters of solution gave a transudate of 140 cubic centimeters in  $2\frac{1}{2}$  hours and in 24 hours the abdomen was again free of fluid. We found that when only a single injection representing the maximum safe dosage was given the abdomen

was fluid free at the end of 24 hours. As we had in mind the possibility of preventing encapsulation and of maintaining the patency of the drain over a period of at least 2 days injections were made into the abdomen of the animals at periods ranging from 10 to 12 hours. In a 20 pound dog 175 to 200 cubic centimeters (35 grams to 40 grams dextrose) of solution was injected. If the animal was operated on between 2 and 3 p.m. a second injection was given at 11 p.m. Only 100 to 125 cubic centimeters were given at the second injection. The intervals elapsing between the first two or three injections must not be more than 12 hours because of the rapidity with which the transudate is absorbed particularly during the first 24 hours. The presence of fluid in the dog's abdomen is readily detected by palpation and we used this as a guide in determining the amount of solution to use at subsequent injections. After the first 24 hours the rapidity of absorption of the transudate seemed materially lessened; the amount of solution necessary to maintain the transudate could then be reduced approximately 25 per cent.

Autopsies were done at intervals of 1, 2 and 3 days. As far as we were able to determine a dog of a given weight, under identical conditions and getting the same amount of dextrose at each injection had no more transudate at the end of the third day than at the end of the first. A dog weighing 25 pounds who had been given five injections amounting to 800 cubic centimeters over a period of 2 days had as a rule from 400 to 500 cubic centimeters of tran-



Fig 3



Fig 4



Fig 5

Fig 3 No encapsulation at the end of 48 hours



Fig 6

Fig 4 A tiny strand of fibrin after 28 hours serves to emphasize the absence of encapsulation

Fig 5 Partial failure When volume of transudate is insufficient plugging of drain openings by omentum occurs

Fig 6 Multiple drains remain unencapsulated save in this instance for slight fixation of omentum to lower left tube

sudate The largest transudate obtained was 1300 cubic centimeters in a 44 pound dog When the volume ran below 300 cubic centimeters in a 20 pound dog at the end of 24 hours, there was usually a partial encapsulation of the drain Several times, however, the volume ran below the above figure, and there was no encapsulation, indicative probably of a normal variation in the fibrin forming capacity of different animals

The transudate was typically serous, and almost always faintly blood tinged The peritoneum retained its normal luster, and was

free from other change except for the presence of fine ecchymoses There was no gross hemorrhage even in animals which died from dehydration The peritoneal pathology could be described as a mild serous peritonitis The most striking findings, however, were

First, the complete or, where partial failure was recorded the almost complete absence of fibrin When fibrin was present, either an insufficient transudate had been produced, or leakage around the drain had occurred It was possible to eliminate fibrin to the finest strand



Fig. 7 (left) Twenty four hours following the application of tincture of iodine to about 16 inches of small bowel. Almost all of the small bowel and omentum agglutinated into one solid mass forming a tumor readily palpable through the abdominal wall.



Fig. 8 Iodine peritonitis which has been treated with hypertonic dextrose solution for 24 hours. The inflamed loop is seen to the left. There is very little fibrin. There are no adhesions and the omentum to the right is free from infiltration.

Second rubber drains in the presence of this transudate remained entirely unencapsulated not only by the bowel but also by the omentum. The latter structure is far more active in the process of encapsulation than the bowel and when a result classified as a partial failure was obtained the omentum was invariably found wrapped about one end of the tube.

Third when fibrin formation was prevented the omentum remained entirely free from infiltration a fact of interest because migration of the omentum toward a foreign body is always associated with an obvious gross infiltration assumed by some observers to be the mechanism responsible for such migration. In its migration toward a drain the omentum has an uncanny affinity for the open end of the drain which it promptly plugs, even though the remainder of the drain be entirely free. When the end of a drain becomes plugged by omentum mere contact between this infiltrated portion of omentum and hypertonic solution will not restore the patency of the drain. In two of our earlier animals, dextrose was introduced after encapsulation had been present for 8 hours. After 48 and 72 hours both drains were almost completely encapsulated.

In a second series of experiments tincture of iodine was used to produce a chemical per-

itonitis with subsequent adhesions between contiguous loops of bowel and omentum. The iodine was painted on the small bowel and at once rubbed off with dry gauze somewhat abraiding the serosa. This promptly produces a violent reaction in the bowel visible in a few minutes. Within 24 hours this invariably produces a tumefaction palpable through the abdominal wall consisting of bowel several times the amount so treated and omentum agglutinated into one solid mass. In nine animals so treated dextrose solution was injected after closure of the abdominal wound. An interval of 20 to 30 minutes following the application of the iodine was allowed to elapse before the dextrose came into contact with the bowel. Excepting for two deaths, one from iodine poisoning and one from dehydration agglutination between contiguous inflamed loops and omentum was prevented although here and there a strand of fibrin was present. This constitutes a much more severe test of the action of dextrose than that of a sterile drain because of the greater degree of inflammatory reaction present. It cannot be argued that the presence of the dextrose a short time later washes off the iodine and so prevents inflammation because at autopsy a day or two later the brittle infiltration of the involved loops and hemorrhages in the mesentery are proof of the damage inflicted.

## DISCUSSION

Two questions remain to be answered (1) what are the possibilities for harm and (2), what clinical application has this work?

The greatest danger, in fact the only serious one, is that of dehydration. In a total of 56 animals there were 5 deaths from this cause the earliest death being 8 hours after the first injection, the latest at 46 hours, 2 died in the vicinity of 24 hours. In all 5 the maximum safe dose had been far exceeded.

Reschke ascribed the danger as being essentially due to extensive dehydration of red cells. An irreparable injury done by this process can easily be recognized according to Hamburger (1) by the extravasation of coloring matter from the red cells. The resistance of the red corpuscles to dehydration has a certain range of variation but if exceeded, hemolysis occurs. Kuhn found that 50 per cent solutions of grape sugar amounting to from one thirtieth to one twentieth of the body weight caused the death of the animal in a short time, but that a solution representing one fiftieth of the body weight in such concentration was readily tolerated. Kuhn, however, did not carry his animals over repeated injections. The latter dose (one fiftieth) is materially in excess if repeated at 12 hour intervals, for nausea develops in dehydration and the animals will not drink. On the other hand we have carried a control animal for 5 days with his abdomen full of fluid with no obvious disability or impairment to health, and on an amount of solution running from 30 per cent to 40 per cent below the safe limit.

We did not routinely inject saline solution, as did Reschke in his studies on the cryoscopy of the blood and transudate. Repeated injections of normal salt solution would undoubtedly raise the limit of safety, both as to the amount of solution injected, and the number of injections given, and is a procedure that is easily followed in the human. Kuhn demonstrated experimentally that with simultaneous subcutaneous injections of normal salt solution, larger doses of sugar solution of the same concentration will be tolerated intraperitoneally.

Local damage to the peritoneum may be disregarded, microscopically only a serous

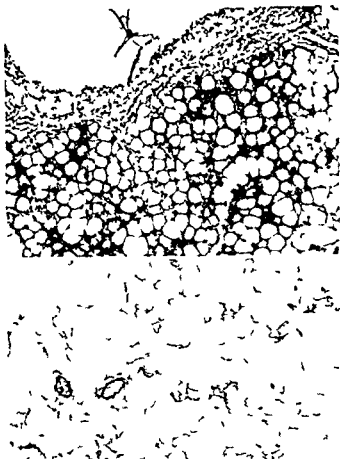


Fig. 9 (above) Omentum showing infiltration the equivalent of a moderate grade of peritonitis resulting from contact with a sterile drain  $\times 63$ .

Fig. 10 The microscopic as well as the gross appearance of the omentum remains almost unchanged in the presence of a drain when dextrose solution is used.

peritonitis is produced. The inflammatory reaction in the omentum to a sterile foreign body is far in excess of the changes produced in that structure by dextrose.

The question of taxation of sugar tolerance is not one of moment. Animals injected over a period of 48 hours almost invariably had a glycosuria and a marked hyperglycemia. The use of insulin may occasionally be desirable. On the other hand the rapid excretion of the sugar was obvious from the rapidity with which it disappeared from the transudate. Within 6 hours after an injection ranging from 150 to 200 cubic centimeters or more, depending upon the weight of the animal, it was a common observation that the transudate contained no dextrose or only a trace.

As to the clinical application of the results of this study, our work is manifestly incomplete, in that it does not include studies of



peritoneal absorption in the presence of dextrose and the possibilities for prolonged drainage in bacterial peritonitis. Our studies so far demonstrate that in animals hypertonic dextrose solution will prevent fibrin formation in the presence of a sterile peritonitis of moderate grade. If further study leads to the conclusion that the same conditions hold true for bacterial peritonitis then such a procedure as has been detailed will have a field of usefulness in cases of severe diffuse peritonitis.

#### CONCLUSIONS

- 1 Hypertonic dextrose solution injected intraperitoneally produces a transudate.
- 2 If the amount of such transudate is sufficient fibrin formation can be prevented.

3 By this means the patency of a drain within the peritoneum can be maintained for several days.

4 In a similar manner adhesions between inflamed loops of bowel can be prevented.

5 The method opens up possibilities in the prolonged drainage of the peritoneum in cases of diffuse peritonitis.

6 It is devoid of danger if dehydration is prevented.

The writer wishes to acknowledge the valuable assistance in the experimental work of L. W. Christian, G. C. Foster and P. W. Butz.

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# AN UNUSUAL FATAL OPERATIVE WOUND INFECTION YIELDING A PATHOGENIC ANAEROBE OF THE GAS GANGRENE GROUP NOT HITHERTO DESCRIBED

WITH DIRECT REFERENCE TO CATGUT AS A SOURCE

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**G**AS gangrene in its clinical manifestations came into the experience of a host of surgeons during the World War. But the majority of army surgeons and bacteriologists had no very clear conception of the etiology of the disease. It was generally believed that "gas gangrene" was caused by the "gas bacillus" and this signified to most minds the Welch bacillus, *Bacillus aerogenes capsulatus* (10).

It was of course no newly recognized infection. The process had been described under a multitude of names by a multitude of surgeons of the older generation, each one apparently attaching to it a name depicting that particular clinical feature with which he was most impressed, for example "traumatic gangrene," "gangrenous phlegmon," "putrid emphysema," "bronzed erysipelas," "malignant oedema," etc., etc.

It was early recognized that anaerobic organisms were chiefly concerned in the infection but the inherent technical difficulties in obtaining and maintaining pure cultures of these organisms, the inadequate differential methods and descriptions, as well as the chaotic conditions of the taxonomy, led to great confusion and controversy. On the one hand, different organisms or mixtures of organisms were called by the same name because they were derived from clinically similar cases and on the other hand the same organism was often given different names when isolated from cases judged clinically different.

During the war, the large number of cases occurring among the wounded soldiers, rendered imperative a re study of the whole matter from a modern point of view but, in the temporary war hospitals, the facilities were not available for making careful analyses of the anaerobic flora of infected wounds. In

the great majority of cases the wounds were contaminated with mixtures of organisms both aerobic and anaerobic. When cultures were made from such wounds the very pressure of time made identification of species next to impossible. In some of the larger hospitals and hospital center laboratories where there were bacteriologists equipped for careful anaerobic studies it soon became evident to all workers in that field that the clinical disease called "gas gangrene" was not a biological entity. *Bacillus aerogenes capsulatus* was frequently found to be missing from the wounds, and other organisms were present in its stead.

But the anaerobic methods in use at that time made the isolation of pure cultures so difficult that the literature during and immediately after the war became filled with erroneous data on the cultural characteristics of the gas gangrene organisms. Gradually however, technical methods improved and now owing especially to the efforts of Weinberg and Seguin (9), Sacquepée (8), McIntosh and Gildes (5), Henry (4), Bulloch (2), Robertson (7), Bull and Pritchett (1), Hall (3), and many others, our knowledge of the bacteriology of gas gangrene, slight as it still is, has become more nearly commensurate with that of our ordinary aerobic wound infections.

It is now generally recognized that gas gangrene is not a specific infection (as, for instance, is erysipelas, caused always by the haemolytic streptococcus), and that there is no specific "gas bacillus" responsible for all cases, that the infection is commonly, but by no means always, a mixed one, and that several varieties of sporebearing organisms (called generically clostridia in the recently adopted nomenclature) can, with care, be isolated in the great majority of traumatic cases as they



Fig. 1 (left) Section from abdominal wall lesion. *A* Surface exudate containing colonies of cocci and bacteria. *B* Subcutaneous fat with cellular and fluid infiltration architecture well preserved. *C* Connective tissue well preserved. *D* Muscle with cellular and fluid infiltration. Fibers widely separated.



Fig. 2 Section from abdominal wall lesion of patient. Large Gram positive spore-forming bacilli in the connective tissue of the subcutaneous fat. Architecture well preserved. (Oil immersion lens  $\times 1000$ ).

commonly occur. It is further recognized that these clostridia are naturally saprophytic inhabitants of the intestinal canal of man and domestic animals and of the soil contaminated by their excreta; that they are only rarely conveyed from one wound to another in the form of a contagium and that practically all such wounds become infected by dirt or other material more or less immediately contaminated by soil or intestinal contents.

But among the multitude of anaerobic organisms obtained by various workers from cases of gas gangrene only a few species of those described have consistently met the requirements necessary to establish them as direct causative agents of the condition. The great majority of the varieties isolated have in pure culture either proved entirely innocuous to experimental animals or else have become so after one or two generations of transplants, although some of these may have enhanced the severity of an infection by their presence in a mixed flora.

Three or four separate species, however, have consistently maintained their virulence over prolonged periods of time and, when inoculated intramuscularly into laboratory animals, are regularly able to produce more or less accurately the lesions of gas gangrene. These are:

1. *Clostridium welchii* (*Bacillus aerogenes capsulatus* discovered by Welch in 1892; *Bacillus perfringens* of Veillon and Zuber; *Bacillus phlegmonis emphysematosae* of E. Fraenkel).

2. *Clostridium oedematis maligni* (*Vibrio septique* first described by Pasteur in 1871; *Bacillus oedematis maligni* of Koch; *Bacillus of Ghon* and Sachs I).

3. *Clostridium novyi* (*Bacillus oedematis maligni* II discovered by Novy in 1894 and rediscovered by Weinberg and by Sacquepée almost simultaneously and named by them respectively *Bacillus oedematis* and *Bacillus bellonensis*).

To these three may perhaps be added *Clostridium histolyticum* (*Bacillus histolyticus* first described by Weinberg in 1911). This organism does not produce the toxemia so characteristic of the disease under discussion, although it is able to cause extreme local destruction and digestion of the living tissue when



Fig. 3 (left) Section from the patient's liver. Extensive destruction of the liver tissue somewhat more marked around the central veins than around the portal areas.

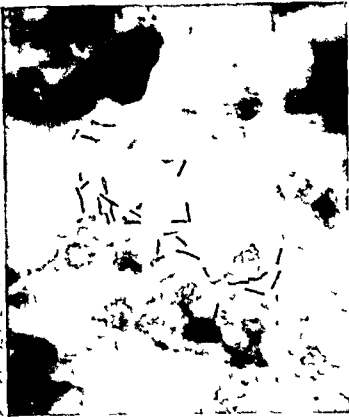


Fig. 4. Section from the patient's liver. Large gram-positive spore-forming bacilli scattered diffusely through the tissue. (Oil immersion lens,  $\times 1000$ .)

injected in sufficiently large amounts into guinea pigs.

Each of the series mentioned is an entirely distinct species comprising strains which may vary in minor cultural features in their agglutinins and in the degree of their pathogenicity but which possess in common certain fundamental characteristics rendering their differentiation from the other species not a particularly difficult matter. Moreover, each species produces a greater or less amount of highly specific exotoxin *in vitro* for which a specific antitoxin may be prepared. This fact is of the utmost importance in the final identification of any particular culture of a pathogenic anaerobe. For while, on the one hand, the antitoxin prepared from one strain of any given species is equally effective against any other cultural or agglutinative variant of the same species, on the other hand it is never effective against the toxin of any strain of any of the other species.

One or other of these three species, with rare exception, has been regularly isolated

from all cases of fatal human gas gangrene. Therefore, it is not without interest that we have obtained, from a fatal case, a clostridium which does not culturally agree with any of the others, which produces a true exotoxin not neutralizable by the antitoxins for any of the others and whose specific antitoxin is ineffective against any of their toxins.

It is of additional interest that we have been able to trace the source of the infection to the introduction into an operative wound of material contaminated with animal intestinal contents, that is, to surgical catgut which was not sufficiently "sterilized." Catgut, as is well known, is manufactured from the muscularis mucosae of the intestine of sheep.

The purpose of this paper is to present the results of certain observations on this organism. We wish to report its characteristics in some detail and to discuss briefly its general significance.

First we will present the clinical aspects of the case from which the organism was taken.

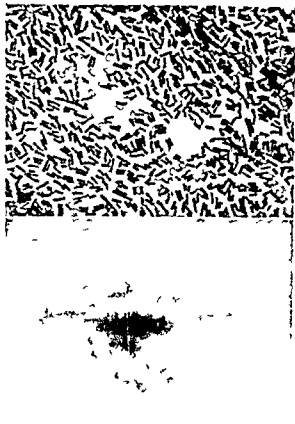


Fig. 5 (above). *Clostridium oedematoides* in a smear from a blood agar plate. Twenty hours growth. Large gram positive pore forming bacilli with pores paracentral when in the bacilli but most of them free. ( $\times 1000$ )

Fig. 6. Colony of *Clostridium oedematoides* on a blood agar plate. Twenty hours growth. The colony usually stellate with the long diameter in the direction of the streak of the inoculating needle. ( $\times 35$ )

#### CASE HISTORY

The patient was a middle aged woman in good general condition suffering from fibrosis uteri with profuse uterine bleeding. She was cared for in an other hospital by one of us (I. C.). A supravaginal hysterectomy was performed through a median hypogastric incision. The appendix was also removed the stump ligated with plain catgut carbolized and not inverted. Plain catgut was used for the pelvic sutures. The peritoneum was closed with continuous plain catgut. The fascia was sutured with chromic catgut and the skin with silk.

The course during the first week following the operation was without incident save for the fact that the temperature curve was slightly higher than usual. On the first and second days it reached 101.8 degrees F. On the third day it was 101.2 degrees F. On the fourth, fifth and sixth days it reached 100.4 degrees F. and on the seventh day fell to 100 degrees F. During this period the pulse ranged between 90

and 115 and on the seventh day it was 92. The skin sutures were removed on the sixth day and there was apparently primary union but the wound edges were slightly oedematous. On the eighth day the temperature rose again to 102 degrees F. and there was severe pain in the back. Herpes of the right buttock was noted. There was considerable pain in the region of the wound. These symptoms and signs increased during the next 24 hours. On the ninth day the external genitalia became very oedematous without apparent cause and the temperature reached 102.2 degrees F. When the wound was dressed on the tenth day it was found that there was a diffuse cellulitis of the abdominal wall below the umbilicus. Redness, pitting oedema of the skin and tenderness over the inflamed area increased during the next day. On the fourteenth day 4 days after the appearance of the brawny induration it was deemed wise to incise a softened area over the lower right rectus muscle. No free pus was found but a profuse serosanguineous exudate filled the incision. The abdominal fat was firm and white resembling bacon fat. There was practically no bleeding. Routine aerobic cultures at the time of this operation yielded no organisms. Following the operation there was some relief from pain but the indurated area gradually extended laterally and profuse serous discharge soaked the dressings. Aerobic and anaerobic cultures from the wound surface on the day after the operation were negative. An aerobic blood culture failed to show any growth.

On the fifteenth day after operation Dr. Albert A. Berg saw the patient in consultation and called the condition woody phlegmon. He advised the application of hot flaxseed poultices and gave a good prognosis. Thereafter the patient's temperature rose daily to 101.4 degrees F. and 101.6 degrees F. The pulse ranged from 90 to 140 and it was of poor quality. There was very little tendency to the formation of granulations in the wound. Her general condition however remained fairly satisfactory. The urinary output was good.

On the nineteenth day after the operation the lower left rectus region was incised down to the posterior rectus sheath. The findings were the same as on the right side. The fat showed occasional necrotic foci and the muscle was very oedematous. Cultures of the fluid and a tiny bit of fat were taken by another bacteriologist. Again no organisms were obtained by aerobic and anaerobic methods. There was little if any improvement following the last operation.

On the twentieth day the patient was seen by Dr. Joseph A. Blake who considered the condition to be a diffuse phlegmon in which pus might eventually form. He believed the incisions and the poulticing to be beneficial. His prognosis was favorable. On the twenty first day the patient began to fail. Her pulse became weaker and more rapid. She became drowsy and was irritable when aroused. Five days later the original median wound began to break down and it was opened with scissors without an

anesthetic. No frank granulations could be seen. Discharge of the same character is noted in the other wounds exuded from the wound surfaces.

On the twenty seventh day, one of us (I. I. M.) was asked to see the case. The possibility of a clostridium novyi (bacillus oedematis) infection was discussed. Cultures were taken from the surfaces of all three wounds. Hemolytic staphylococcus aureus non hemolytic streptococcus and bacillus subtilis were obtained. No anaerobic organisms were found.

A transfusion was followed by temporary improvement in the patient's general condition for 4 days although the temperature during this period reached 103.8 degrees F. Subsequently the temperature rose to 104.4 degrees F. Then the patient became very much more restless and irritable with cold perspiration, nausea and vomiting. There was progressive weakness of the pulse.

On the thirty fourth day, 50 mls of clostridium novyi (bacillus oedematis) serum were given intramuscularly in the abdominal wall and thigh. There was no evidence of improvement. She became more drowsy and the pulse gradually mounted and weakened. Dr. Howard Lilienthal was called in at this time. He said that he had never seen a condition like it before. He believed it to be an infection in spite of the negative cultures from the tissues. He advised as a last resort excision of the involved subcutaneous tissue leaving the skin intact. He favored loose packing of the wound and recommended transfusion both before and after the operation. A transfusion given at this stage was followed by a chill and fever reaching 106 degrees F. The pulse became imperceptible and she expired conscious almost to the end.

An autopsy was performed about 10 hours after death. The three longitudinal wounds in the lower part of the abdomen were covered with thick purulent exudate. The lower half of the abdominal wall was twice its normal thickness and it had a board like consistency. No crepitation was felt. All of the layers including the peritoneum were indurated and oedematous. The larger subcutaneous vessels were thrombosed. There were small ecchymotic areas in the involved tissues but no free pus. When the peritoneal cavity was opened about 50 mls of amber colored fluid were found as well as some flakes of fibrin on the coils of the small intestine. The appendix stump was smooth. There was no thrombosis of the vessels of the abdominal cavity. The liver and spleen were congested. The kidneys showed nothing remarkable. About 50 mls of amber colored fluid were found in the pericardial sac. There were adhesions between the parietal and visceral pleurae on the right and both lungs were oedematous.

The microscopic examination of the lesion in the patient showed an extensive oedema of the subcutaneous fat and muscle and a dense infiltration with mononuclear and polynuclear wandering cells. There was surprisingly little destruction of the fatty



Fig. 7. The lesion of clostridium oedematis in a guinea pig (one half life size). The pig died from 16 to 20 hours after the injection of 0.5 cubic centimeter of a 20 hour culture into the lower midline of the abdominal wall. It produced an extensive jelly like oedema of the whole abdominal wall which was hemorrhagic around the point of inoculation.

tissue but the muscle fibers appeared to be atrophied as if by pressure (Fig. 1). The oil immersion lens revealed gram positive rods in great numbers through the fat. These were distributed irregularly. In some places they were very dense and in others absent or very sparse (Fig. 2). The liver showed extensive diffuse degeneration which was chiefly around the central veins (Fig. 3) and many spore forming rods were found all through the tissue (Fig. 4). The kidneys showed some destruction of the tubular epithelium but this was not striking. The other tissues showed nothing remarkable.

At autopsy an opportunity was given one of us (I. I. M.) for obtaining material from the lesion for culture. The skin was painted with 7 per cent iodine and a fresh incision was made into the abdominal wall. Large pieces of the oedematous fat and muscle were excised for bacteriological study. This tissue yielded only two organisms, one aerobic bacillus pyocyaneus and one anaerobic which could not be identified. It was found that this anaerobe, in pure culture produced a lesion in a guinea pig which was similar to the lesions caused by clostridium novyi and clostridium oedematis malignum but which differed somewhat from them. It was further found that it was different from these other species in certain of its cultural characteristics. It became evident that the organism warranted further study to determine whether or not it was pathogenic for



Fig. 8 The lesion of clostridium oedematoides in a dog (about one sixth life size). The dog died three days after the injection of 1.5 cubic centimeters of a 20 hour culture into the subcutaneous tissues of the abdominal wall just to the right of the midline. It produced an extensive hard, slightly hemorrhagic oedema of the whole thickness of the abdominal wall resembling closely the lesion in the patient.

other animals and whether or not it would maintain its pathogenicity over a period of time. It was also necessary to subject it to various cultural and serological tests to differentiate it from the other well known organisms of the gas gangrene group.

#### A DESCRIPTION OF THE ORGANISM

We have called this anaerobic clostridium oedematoides to indicate its similarity to the other organisms of this group.

#### MORPHOLOGY

**Form.** It is a large bacillus varying from 1 to 4  $\mu$  in length and from 0.3 to 0.5  $\mu$  in width. The ends are square rather than rounded. It generally occurs singly but may be in pairs or chains of three or four. Rarely short threads have been observed corresponding in length to four or five individuals. It is strongly gram positive in young cultures but on further incubation or on standing some individuals become gram negative (Fig. 5).

**Spore formation.** Spores are readily formed. They are generally paracentral but they may be central or subterminal. Spores are formed in large numbers in plain broth in 20 hours but are not usually seen in 1 per cent dextrose broth until the third or fourth day of incubation. Many spores are present in 20 hour cultures in cooked meat medium without



Fig. 9 The lesion of the toxin of clostridium oedematoides in mice. The mouse on the right died overnight with a large dose of toxin. The mouse on the left died in 3 days with a small dose of toxin. The oedema is usually greatest when death occurs slowly.

dextrose and a fair number when 0.2 per cent dextrose is present in the meat medium. Whenever spores are found a large proportion of them are free. Spores have been observed but are very much less numerous in the experimental lesions in animals and in the blood of animals killed by the infection.

**Capsule formation.** The vegetative forms have no capsule but the spores appear to have a thin capsule with the Hiss stain.

**Motility.** The organism is actively motile in young cultures. In cooked meat medium both with and without 0.2 per cent dextrose after four and a half hours of incubation many motile forms are present. After 9 hours of incubation the organisms in the dextrose medium are distinctly less motile while in the medium without dextrose they are still very active. After 20 hours only a few actively motile individuals are seen even in the culture medium free from dextrose.

#### CULTURAL CHARACTERISTICS

**Anaerobiosis.** To obtain anaerobiosis for this study we have used a modification of the McIntosh and Fildes jar (6). This gives complete anaerobic conditions and permits the use of any media used in aerobic cultivation. Methylene blue in 1 per cent dextrose broth

is used as an indicator of the complete reduction of the atmosphere within the jar. This organism is a strict microbe. It grows readily under anaerobic conditions as *Clostridium welchii* and *Clostridium oedematis maligni*. It does not require a complete anaerobiosis as *Clostridium novii*.

**Growth on solid media.** On 5 per cent sheep's blood agar in petri plates the colonies are discrete and stellate with the long dimension generally in the direction of the streak made by the transplanting needle. The margin is very irregular (Fig. 6). Occasionally a fern-like spreading is seen from the edge of some of the colonies. When this was first observed it was thought that there was a contaminating organism present, but repeated transplantations showed that such was not the case. It is believed that this fernlike spreading margin depends upon variations of moisture condensation on the surface of the media. The colonies are grayish in color. Rarely there is a slightly greenish tinge around the colony. No hemolysis is evident but when the colony has been removed from the surface of the blood agar there is a faint pallor to be seen in the underlying media. In agar tubes the deep colonies are small, discrete, and mossy. In dextrose agar the medium is fragmented by the gas which is formed.

**Fluid medium.** In plain meat infusion broth it grows readily with a cloudy suspension increasing in density from the surface downward. When the tube is rotated it is seen that the growth has a thick, tenacious appearance and when it is taken up in a pipette its mucoid character is evident. In dextrose broth, this is not present except in old cultures, and there seems to be a definite correlation between the mucoid character and sporulation. In cooked meat medium the mucoid character is again a prominent feature in old cultures. The growth is diffuse and gradually settles, but does not leave the supernatant fluid clear except after standing for several days. If left in the air at room temperature the upper part of the supernatant fluid clears and a condensed ring 3 to 5 millimeters wide forms about 2 centimeters from the surface. Below this the suspension is thinner but increases in density down to the meat at the bottom.

**Gelatin.** When grown on gelatin there is no rapid change but liquefaction is complete in 48 hours.

**Fermentative action.** When grown on 1 per cent sugar media it is not active except in dextrose in which it forms large quantities of gas and acid. Although growth is profuse in other sugar media, no acid and no gas are formed in lactose, saccharose, sucrose, mannite or glycerin.

**Milk.** With litmus as an indicator milk shows a very slight purpling after 72 hours. There is no clotting but the medium becomes somewhat thicker. After 3 or 4 days growth in milk there is evidence of partial digestion.

**Proteolytic action.** After prolonged incubation there is slight surface erosion of Loeffler's medium but no real liquefaction. In meat medium there is no digestion of meat fibers although there is some darkening of the surface layer of the meat after some days. The odor of the gas produced on cooked meat medium is foul but not distinctive. It is not a butyric acid odor but rather resembles that of old cheese.

**Thermal death point.** It is well known that the thermal death point of spore forming organisms depends to some extent on the age of the culture and the reaction of the medium in which the culture is heated. Under certain constant conditions however, the various species show some differences of resistance with considerable regularity. After growing for 20 hours in 0.2 per cent dextrose cooked meat medium 5 drops are transferred to several tubes of fresh medium. These tubes may then be heated at different degrees of temperature for constant periods of time and then incubated in the usual way. Under such circumstances the spores of this organism resist 85 degrees C. for 15 minutes but are usually destroyed by 90 degrees C. for the same length of time.

#### PATHOGENICITY

**Pathogenicity for laboratory animals.** *Clostridium oedematoides* is lethal in small doses for mice, rats, guinea pigs, rabbits, cats, dogs, pigeons, and chickens. No other animals have been used. The effect has been so prompt in these animals that there is little doubt of its



TABLE I—PATHOGENICITY OF CLOSTRIDIUM CLOSTRIOIDES—20-HOUR CULTURES WERE USED

	Dose	Death occurred
0.1 mil for a 20 gram white mouse	Over night	
0.5 mil for a 350 gram white rat	In 3 days	
0.25 mil for a large pigeon	In 6 hours	
0.25 mil for a 350 gram guinea pig	Over night	
0.0 mil for a 2500 gram rabbit	In 20 hours	
0.50 mil for a large chicken	In 30 hours	
1.0 mil for a 4500 gram cat	In 3 days	
1.5 mils for a 15 kilo ram dog	In 3 days	

general pathogenicity. When a 20 hour culture in 0.2 per cent dextrose cooked meat medium is injected subcutaneously into animals in doses ranging from 0.1 cubic centimeter for a 20 gram mouse to 1.5 cubic centimeters for a 15 kilogram dog it kills the animal in from 10 to 7 hours. The organism may be recovered from the lesion, the peritoneum and the heart. The typical lesion in a guinea pig is an extensive slightly hemorrhagic edema of the subcutaneous tissues (Fig 7). It is not as extensive nor as colorless as the typical lesion of the clostridium novyi. It is not as hemorrhagic and the muscles are not as red as the typical lesion of clostridium edematis maligni. It is rather midway between these two with resemblances to both. Gas formation is minimal but is present to some degree in the muscle. The edema is most marked when death occurs slowly. In the cat and in the dog the lesion resembles the human pathology more closely than in the other animals. This may be due to the denser subcutaneous tissues in these animals. In cats and dogs these tissues are enormously thickened with a rather firm but exceedingly moist edema from which a sero sanguineous fluid escapes on incision (Fig 8). Not long before death pigeons, guinea pigs, rabbits and mice show a paralysis of the muscles. Clonic convulsions may develop immediately before the end.

The minimal lethal doses for these laboratory animals have not been determined. Fatal doses all given subcutaneously are shown in Table I.

*The maintenance of pathogenicity for laboratory animals.* The strain has been transferred scores of times on several different kinds of artificial media over a period of 2 years and it has maintained its active pathogenicity.

TABLE II—THE PROTECTIVE EFFECT OF THE IMMUNE SERUM

The sera and toxin were mixed and incubated for one hour at 37.5 degrees C. before subcutaneous inoculation.			Result
1	Serum rabbit No. 49 (6 serial subcutaneous inoculations) 0.25 mil + Clostridium edematis toxin 0.25 mil		Survived
2	Serum rabbit No. 48 (5 serial intravenous inoculations) 0.25 mil + Clostridium edematis toxin 0.25 mil		Survived
3	Normal rabbit serum 0.25 mil + Clostridium edematis toxin 0.25 mil		Did not survive
4	Plain broth 0.25 mil + Clostridium edematis toxin 0.5 mil		Did not survive
5	Serum rabbit No. 49 0.10 mil + Clostridium edematis toxin 0.40 mil		Survived
6	Serum rabbit No. 49 0.05 mil + Clostridium edematis toxin 0.45 mil		Survived

*Pathogenicity for man.* A description of the human lesion both gross and microscopic is given in the case history. These findings were consistent with the clinical aspects of the case and seemed to indicate that the organism which was found was responsible for the lesion and for the fatal outcome. Its occurrence in a fatal lesion in man when considered with its pathogenicity for animals would tend to lend weight to the belief that it is also generally pathogenic for man.

#### TOXIN PRODUCTION

The organism produces a true exotoxin filterable, thermolabile, having a latent period and capable of stimulating an antitoxin when injected in sublethal doses into animal. Toxin is produced both in plain meat infusion broth and in cooked meat medium. It is somewhat more powerful in plain broth culture than in the meat medium and 20 hour cultures in both media yield more active toxins than cultures incubated for 1 week. The filtrate from a 20 to 24 hour culture in cooked meat medium with 0.2 per cent dextrose is highly toxic for mice, guinea pigs and rabbits. The minimal lethal dose of this toxin for a 20 gram white mouse is approximately 0.02 cubic centimeter. The minimal lethal dose for a 350 gram guinea pig lies between 0.1 cubic centimeter and 0.25 cubic centimeter. The

TABIE III—THE ABSORPTION OF PROTECTION AGAINST CLOSTRIDIUM OEDEMATOIDES TOXIN WITH POTENT CLOSTRIDIUM WELCHII CLOSTRIDIUM NOVI AND CLOSTRIDIUM OEDEMATIS MALIGNI ANTITOXINS

The sera and toxins were mixed and incubated for one hour at 37.5 degrees C before subcutaneous inoculation

Mouse	Results
1 Clostridium welchii antitoxin 0.25 ml + Clostridium oedematoides toxin 0.5 ml	Died over night
2 Clostridium welchii antitoxin 0.5 ml + Clostridium oedematoides toxin 0.02 ml	Died in 36-48 hours
3 Clostridium novyi antitoxin 0.25 ml + Clostridium oedematoides toxin 0.25 ml	Died over night
4 Clostridium novyi antitoxin 0.25 ml + Clostridium oedematoides toxin 0.02 ml	Died in 7-80 hours
5 Clostridium oedematis maligni antitoxin 0.25 ml + Clostridium oedematoides toxin 0.5 ml	Died in 36 hours
6 Clostridium oedematis maligni antitoxin 0.25 ml + Clostridium oedematoides toxin 0.02 ml	Died in 56-64 hours

lesion in these animals which the toxin produces is chiefly a jellylike edema not unlike that produced by the clostridium novyi. It has not the hemorrhagic element seen in the lesion produced by the whole culture. When given in large doses the toxin kills promptly and there is very little edema but in small doses the edema increases gradually and is very marked at death sometimes giving the appearance of mechanically choking the mouse (Fig. 9). One sublethal dose caused a mouse to swell up to almost twice its original size in 4 to 5 days with subsequent subsidence to normal. A mouse that is ill lies quietly with eyes closed and hair bristling. Respirations are deep and slow. As the edema develops, all movements become slow and ponderous. Toward the end it falls over on its side or flattens out as if paralyzed. Occasionally there are a few spasms just before death. Intravenous injection of toxin in rabbits in several instances caused an exudation of fluid into the pleural, pericardial, and peritoneal cavities, with death.

*The latent period of toxin action.* There is no immediate effect following the injection of toxin. Even with large doses several hours elapse before there are signs of intoxication.

TABIE IV—THE RECIPROCAL TESTS WITH CLOSTRIDIUM NOVI AND CLOSTRIDIUM OEDEMATOIDES SERA AND THEIR RESPECTIVE TOXINS

The sera and toxins were mixed and incubated for one hour at 37.5 degrees C before subcutaneous inoculation

M use	Results
1 Clostridium oedematoides serum 0.25 ml + Clostridium oedematoides toxin 0.25 ml	Survived
2 Clostridium oedematoides serum 0.25 ml + Clostridium novyi toxin 0.25 ml	Died over night
3 Clostridium oedematoides serum 0.25 ml + Clostridium novyi toxin 0.05 ml + broth 0.20 ml	Died over night
4 Clostridium novyi serum 0.5 ml + Clostridium novyi toxin 0.25 ml	Survived
5 Clostridium novyi serum 0.25 ml + Clostridium oedematoides toxin 0.5 ml	Died over night
6 Clostridium novyi serum 0.25 ml + Clostridium oedematoides toxin 0.05 ml + broth 0.20 ml	Died in 30-40 hours

*The deterioration of toxin.* The toxin gradually loses some of its potency even if kept sealed in the ice box. The minimal lethal dose of one filtrate increased from 0.02 to 0.05 in the course of a month. This deterioration takes place more rapidly at room temperature.

*Thermolability of the toxin.* The toxin is destroyed by boiling for 5 minutes or by heating at 56 degrees C for 1 hour. It is greatly attenuated but not entirely destroyed by heating at 56 degrees C for 30 minutes. Lower temperatures down to 37.5 degrees C attenuate it slightly.

# ANTITOXIN EXPERIMENTS

*The antigenic properties of the toxin.* Antitoxic serum may be obtained in rabbits either by intravenous or subcutaneous inoculation of the filtrate. The doses must be very small and the weight of the animals must be watched carefully. We obtained satisfactory results by the injection of a small dose daily for 3 days out of each week starting with 0.5 ml and gradually increasing the dose with each series. After three series of subcutaneous injections the rabbit's serum showed weak protection. After five such series the serum proved to be of considerable potency. Nine days after the sixth series the animal was killed for serum, after having received 16.5 mls of the toxin in six weeks' time. Then it

TABLE V—THE RECIPROCAL TESTS WITH CLOSTRIDIUM NOVI AND CLOSTRIDIUM ŒDEMATOIDES SERA AND THE CENTRIFUGED SUPERNATANT FLUID OF THEIR RESPECTIVE CULTURES

The sera and centrifuged supernatant fluid were mixed and incubated for one hour at 37.5 degrees C. before subcutaneous inoculation

No.	Use	Result
1	Clostridium œdematoides serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium œdematoides	Survived
2	Clostridium œdematoides serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium novi	Died over night
3	Clostridium novi serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium novi	Survived
4	Clostridium novi serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium œdematoides	Died over night

was found that 0.05 ml of the serum would protect white mice against 0.45 ml of toxin (see Table II). Similarly after five series of intravenous injections with somewhat smaller doses potent serum was obtained in another animal.

*The protective effect of the immune serum*  
The following experiments as shown in Table

TABLE VI—THE RECIPROCAL TESTS WITH CLOSTRIDIUM ŒDEMATIS MALIGNI AND CLOSTRIDIUM ŒDEMATOIDES SERA AND THE CENTRIFUGED SUPERNATANT FLUID OF THEIR RESPECTIVE CULTURES

The sera and centrifuged supernatant fluid were mixed and incubated for one hour at 37.5 degrees C. before subcutaneous inoculation

No.	Use	Result
1	Clostridium œdematoides serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium œdematoides	Survived
2	Clostridium œdematoides serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium œdematis maligni	Died over night
3	Clostridium œdematis maligni serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium œdematis maligni	Survived
4	Clostridium œdematis maligni serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20-hour culture of clostridium œdematoides	Died over night

TABLE VII—THE RECIPROCAL TESTS WITH CLOSTRIDIUM WELCHII AND CLOSTRIDIUM ŒDEMATOIDES SERA AND THE CENTRIFUGED SUPERNATANT FLUID OF THEIR RESPECTIVE CULTURES

The sera and centrifuged supernatant fluid were mixed and incubated for one hour at 37.5 degrees C. before intraperitoneal inoculation

No.	Use	Result
1	Clostridium œdematoides serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium œdematoides	Survived
2	Clostridium œdematoides serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium welchii	Died over night
3	Clostridium welchii serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20 hour culture of clostridium welchii	Survived
4	Clostridium welchii serum 0.25 ml + 0.25 ml of the centrifuged supernatant fluid of a 20-hour culture of clostridium œdematoides	Died over night

<sup>1</sup>An intraperitoneal instead of a subcutaneous inoculation was used in this test because the clostridium welchii toxin was relatively weak

II demonstrate the potency of this new immune rabbit serum against the toxin produced by this organism

*The absence of protection against this toxin by potent clostridium welchii clostridium novi and clostridium œdematis maligni antisera*  
Antisera for clostridium welchii clostridium novi and clostridium œdematis maligni which had previously been demonstrated to be potent in protecting white mice against the toxins of these respective organisms were tested for protective action against this toxin and found to have no effect (Table III)

*The reciprocal tests with clostridium novi and clostridium œdematoides sera and their toxins*  
When these sera were tested against the toxins produced by the homologous and the heterologous species it was found that they were potent against the former but impotent against the latter. These experiments are shown in Table IV

*The reciprocal tests with clostridium novi and clostridium œdematoides sera and their unfiliced cultures*  
When these sera were tested against the centrifuged supernatant fluid of 20 hour cultures containing not only toxin but living organisms the results again

TABLE VIII.—A DIFFERENTIAL CHART SHOWING THE CULTURAL CHARACTERISTICS OF THE PATHOGENIC ANAEROBIC BACILLI OF THE GAS GANGRENE GROUP

Name of species	Spore	Growth on blood agar	Saccharolysis					Proteolysis
			Dex	Lac	Sac	Sal	Gly	
<i>Clostridium welchii</i> (Bacillus aerogenes capsulatus)	+	Discrete run in	+	+	+	o	+	o
<i>Clostridium oedematis maligni</i> (Vibrio septique)	+	Spreading	+	+	o	+	o	o
<i>Clostridium novyi</i> (Bacillus oedematiens)	+	Discrete irregular	+	o	o	o	+	o
<i>Clostridium oedematis</i> (new species)	+	Discrete tell tale	+	o	o	o	o	+

showed strictly specific protection. This is shown in Table V.

The reciprocal tests with *Clostridium oedematis maligni* and *Clostridium oedematis* sera and their unfiltered cultures. The experiments described in the preceding paragraph were repeated with the sera of *Clostridium oedematis maligni* and *Clostridium oedematis*, with almost identical results. These are shown in Table VI.

The reciprocal tests with *Clostridium welchii* and *Clostridium oedematis* sera and their unfiltered cultures. The experiments described in the preceding paragraph were repeated with the sera of *Clostridium welchii* and *Clostridium oedematis* with similar results. It was found that 0.25 ml. of the centrifuged supernatant fluid of the *Clostridium welchii* culture was not sufficient to kill the mouse when injected subcutaneously, but when the experiment was repeated with intraperitoneal injections, the specific homologous protection was evident. The results in this experiment are shown in Table VII.

The differentiation of *Clostridium oedematis* from the other pathogenic anaerobic bacilli. The foregoing experiments with toxins and antitoxins conclusively demonstrate that this organism represents a species distinct from *Clostridium welchii*, *Clostridium novyi* and *Clostridium oedematis maligni*, but for preliminary differentiation, the cultural differences between these pathogenic anaerobes are of prime importance. One may distinguish *Clostridium oedematis* from the others by the following differences:

1. From *Clostridium welchii* by (a) the differences in the colony growth on blood agar (*Clostridium welchii*, if hemolytic, produces a narrow zone of complete hemolysis about the

colony and a wide zone of partial hemolysis. The non-hemolytic strains produce the outer zone only. The colonies are usually round.) (b) The absence of fermentation of glycerin with the formation of acrolein. (c) The absence of acid and gas production with lactose and saccharose. (d) The absence of butyric acid odor in dextrose medium. (e) The greater tendency to spore formation.

2. From *Clostridium oedematis maligni* (Vibrio septique), by (a) the differences in the colony growth on blood agar (*Clostridium oedematis maligni* usually spreads over the plate in a thin film and most strains are hemolytic.) (b) The absence of fermentation of lactose and salicin. (c) The greater tendency to free spore formation.

3. From *Clostridium novyi* (Bacillus oedematiens) by (a) the differences in the colony growth on blood agar (*Clostridium novyi* usually forms distinctly green colonies which are often slightly hemolytic.) (b) The absence of prompt flocculation in fluid media. (c) The absence of fermentation of glycerin. (d) The greater tendency to free spore formation.

These cultural differences are shown in Table VIII.

#### THE SOURCE OF THIS ORGANISM

How this organism entered the body of the patient is a question of great importance. The circumstances were such as to point to an operating room infection. Within a period of 4 days after this case was operated on, four other clean cases in the same hospital, cared for by two other surgeons, developed fatal operative wound infections of the gas gangrene type. These surgeons have very kindly consented to our including in this paper very

TABLE IX—THE PROTECTIVE ACTION OF CLOSTRIDIUM OEDEMATOIDES SERUM ON THE TOXINS FROM CULTURES OF THE CATGUT STRAINS

The sera and the toxins were mixed and incubated for one hour at 37.5 degrees C. before subcutaneous inoculation

Mouse		Results
1	Clostridium oedematoides serum (rabbit No. 49) 0.25 ml + toxin from catgut strain No. 1 0.25 ml	Survived
2	Clostridium novyi serum 0.25 ml + toxin from catgut strain No. 1 0.25 ml	Died over night
3	Normal rabbit serum 0.25 ml + toxin from catgut strain No. 1 0.25 ml	Died in 30 hours
4	Clostridium oedematoides serum (rabbit No. 49) 0.25 ml + toxin from catgut strain No. 2 0.25 ml	Survived
5	Clostridium novyi serum 0.25 ml + toxin from catgut strain No. 2 0.25 ml	Died in 36 hours
6	Normal rabbit serum 0.25 ml + toxin from catgut strain No. 2 0.25 ml	Died over night

brief resumes of their cases. In all of these cases chronic catgut was used for suturing the fascia of the abdominal wall.

CASE 1. The patient was a male age 37. A right inguinal hernia repair and an appendectomy through a right rectus incision were done. The convalescence was normal for 7 days. On the eighth day the rectus wound became slightly indurated but was not painful. The temperature rose to 101 degrees F and the pulse to 90. On the ninth day patient complained of pain in upper incision. The induration had spread and the whole region was very tender. An opening made in the wound failed to reveal pus. Next day the process was intensely painful and the edges of the wound were extremely edematous. The wound was then opened widely and dark blood and gas escaped from it. The temperature mounted to 103 degrees F and the pulse to 120. Leucocytosis was high. On the twelfth day 4 days after the onset of symptoms the patient became cyanotic and the skin cold and clammy. Nausea and impairment of vision developed. The indurated area took on a brownish color and extended downward involving the scrotum. Aerobic blood cultures were negative. On this day the patient died. No cultures were made from the wound. No autopsy was obtained.

CASE 2. The patient was a female age 29. A cholecystectomy and an appendectomy were done through an upper right rectus incision. With the exception of slight elevation of temperature and pulse her condition was satisfactory until the fourth day when her temperature rose to 103.2 de-

grees F and her pulse to 120. There was marked swelling about the upper part of the wound. The patient became nauseated and perspired excessively. She was very restless and apprehensive. On the fifth day her temperature again reached 103 degrees F and the pulse at the wrist became imperceptible. The whole wound became indurated and edematous but there was no discoloration of the skin. During the fifth day the patient became nauseated irritable and restless. She developed a profuse cold perspiration became more and more prostrated and died. Cultures of the wound and blood were not taken and there was no autopsy.

CASE 3. The patient was a female of 25. A Gilliam suspension of the uterus and a left oophorectomy were done. She did well for 4 days. On the fifth day the temperature mounted to 101 degrees F and the pulse to 118. She complained of abdominal pain and felt nauseated, weak and nervous. There was profuse perspiration. The tissues about the abdominal wound were indurated and had a brownish discoloration. The pulse became progressively weaker and she died on the sixth day. Cultures of the wound and blood were not made, and there was no autopsy.

CASE 4. The patient was a female age 20. A ventral suspension of the uterus and an appendectomy were done. She made an uneventful recovery in the hospital and was discharged apparently well on the thirteenth day after operation. Five days after her discharge she was again admitted to the hospital because of pain and induration about her abdominal wound. Her temperature was 100 degrees F and her pulse 90. The tissues about her wound were of the consistency of tanned leather. The wound was opened and drained but no pus was obtained. The tissues were infiltrated with serosanguineous fluid. Microscopic examination of a piece of the fat showed extensive hemorrhagic and edematous changes with some necrosis of the fat and moderate degree of leucocytic infiltration. Aerobic and anaerobic cultures from the wound were negative in 72 hours but inoculation of the fluid into a guinea pig was followed by the death of the pig in 48 hours with edema at the site of injection. Aerobic and anaerobic cultures from the guinea pig were negative. The patient did not improve after the wound was opened. Three days later multiple incisions were made into the involved abdominal wall. Aerobic and anaerobic cultures were again negative. Her temperature and pulse gradually rose and she died 5 days after her second and 18 days after her first operation. No autopsy was performed.

As soon as these cases appeared, an investigation of the operating room technique was instituted by members of the hospital staff. The catgut then in use was all removed and another brand was substituted. Some of the confiscated catgut was sent to an outside bacteriologist who reported that one of the

tubes contained a pathogenic anaerobe which he classified as *Clostridium novyi*.

When we had completed the study of the species described above and had demonstrated that it was not the *Clostridium novyi*, we were eager to make a further study of the catgut. The hospital authorities very kindly furnished us with four tubes of the same batch of catgut. This fortunately had been kept in the bacteriological laboratory since its original removal from the operating room. This catgut was put out in sealed tubes by a reputable firm. In the box containing these tubes were directions stating that the catgut might be used after sterilization of the surface of the tubes. Two of these tubes contained No. 2 chromic catgut and two contained No. 3 chromic catgut. The tubes were flamed and broken. The gut was then quickly transferred to cooked meat medium and incubated anaerobically. From one of the No. 2 chromic tubes were cultured an organism resembling *Clostridium oedematoides* and *Bacillus subtilis*. From the second tube of No. 2 chromic catgut were cultured an organism resembling *Clostridium oedematoides* and a haemolytic strain of *Clostridium welchii*. From one of the No. 3 chromic tubes was cultured the non-pathogenic anaerobe *Clostridium tertium*. From the other tube of No. 3 chromic catgut was cultured a haemolytic strain of *Clostridium welchii* which was culturally different from the *Clostridium welchii* obtained from one of the No. 2 chromic tubes. Thus out of four tubes of the batch of catgut used in the operation room at the time of these five fatal operative wound infections, four strains of pathogenic anaerobes, one strain of a non-pathogenic anaerobe and one strain of an aerobic sporeformer were cultured.

The two strains resembling *Clostridium oedematoides* were then put through a series of cultural tests and they were found to be exactly similar to the strain cultured from the patient. Moreover, filtrates from these cultures and centrifuged supernatant fluids killed mice in the same way and the lesion in guinea pigs could not be distinguished from the lesion produced by the strain of *Clostridium oedematoides* obtained from the patient. Also, the antitoxin prepared against the original

strain protected mice from the filtrates and the supernatant fluids of 24 hour cultures of both of the catgut strains, whereas the *Clostridium novyi* antiserum had no effect. These toxin-antitoxin experiments are shown in Table IX. Thus we were able to demonstrate that the two catgut strains were also *Clostridium oedematoides*.

#### COMMENT

All of these cases were obviously operative wound infections. The failure to obtain positive cultures during life simply means that the methods which were used were not adequate. Even though the oedema fluid in supplementary case No. 4 killed a guinea pig in 48 hours, the organism was not obtained from it at autopsy. It has been observed that the oedematous tissue in the periphery of a *Clostridium novyi* lesion may yield no growth on culture. The oedema is believed to be chiefly a toxic reaction. The organisms may not invade to the periphery. The failure to obtain growth from the oedema fluid or a bit of fat does not mean that the organisms were not present in the lesion during life. The patchy distribution of the organisms as seen in the microscopic slides of the subcutaneous fat of the patient, as mentioned above, is of interest in this connection. The negative results from the surface cultures in our case taken several days after the wounds had been made, were not surprising. These preliminary failures emphasize the necessity for taking large quantities of material in all anaerobic culture work.

It is of significance that chromic catgut was used in our patient only for the aponeurosis of the rectus sheath—plain catgut being used in the peritoneal cavity. The infection arose in, and for a time was limited to, the abdominal wall while the peritoneum and the region of the appendix were quite free.

The infection began at the end of the first week in our patient and at widely varying times in the other cases. This would suggest that the spores were released from the catgut at varying lengths of time as it became absorbed. The cases varied also in their clinical manifestations. Certainly the descriptions of two of them suggest a *Clostridium welchii*

infection while the other two suggest infection with *Clostridium oedematoides*, *Clostridium novyi* or *Clostridium oedematis maligni*. The finding of *Clostridium novyi* by another bacteriologist and our finding of four or five different types of spore forming organisms in the catgut bring out the fact that in a group of infections such as these the causative organisms may well be different and yet come from one general source.

Dr Welch has informed one of us (F. L. M.) that in the early days of Johns Hopkins Hospital on several occasions gas gangrene infections were traced presumably to catgut. It was on this basis that Dr Halsted insisted upon the exclusive use of silk for suture and ligature material in his clinic. As the technique of preparation of catgut improved some of the other clinics reverted to the use of absorbable material and have continued to use it.

It is evident that this batch of catgut was not properly sterilized—the non sporeformers were doubtlessly killed but the spores survived. This represents a break in the technique of preparation which may have existed for an indeterminate period of time. Whether this time was long or short it was sufficiently long to have certain dire consequences. The whole circumstance emphasizes the necessity for every manufacturer of catgut formulating and carrying out with the utmost meticulous care a technique for rigidly testing by adequate aerobic and anaerobic methods each and every batch of catgut put out on the market.

The general significance of this new species can be brought out only by an extensive study of material from many sources to determine its general distribution. This will be attempted.

#### SUMMARY

1. A pathogenic anaerobic bacillus of the gas gangrene group which as far as we know, has not been heretofore described, has been recovered from the lesion in a fatal human operative wound infection in which no other pathogenic organisms were found.

2. The clinical syndrome was characterized by a brawny, red oedematous swelling of the abdominal wall around the wound, severe

pain in the lesion, elevation of temperature, leucocytosis, feeble and rapid pulse, nausea, profuse perspiration and toward the end somnolence, irritability when aroused and finally profound prostration and circulatory failure.

3. The organism cultured from the human lesion is highly pathogenic for the eight different species of laboratory animals which we tested. It has maintained its pathogenicity for these animals over a period of 2 years with frequent transfers on artificial media.

4. It produces an extensive oedematous, slightly hemorrhagic lesion around the site of injection somewhat resembling the lesions caused by *Clostridium novyi* (*Bacillus oedematis*) and *Clostridium oedematis maligni* (*Vibrio septique*).

5. It may be recovered after the death of the animals, from the lesion, the peritoneum and the blood.

6. It differs in some of the fundamental cultural tests from the other well known pathogenic anaerobic bacilli.

7. It produces a true exotoxin.

8. Potent antitoxic sera for *Clostridium welchii* toxin, for *Clostridium novyi* toxin and for *Clostridium oedematis maligni* toxin have no protective action against the toxin produced by (or the culture of) this organism.

9. Potent antiserum has been produced in rabbits by injecting small doses of the toxin of this organism either intravenously or subcutaneously.

10. This antitoxin has no protective action against the toxins or the cultures of typical strains of *Clostridium welchii*, *Clostridium novyi* or *Clostridium oedematis maligni*.

11. Therefore the organism appears to be a highly pathogenic anaerobe of the gas gangrene group distinct from the other three well known species, *Clostridium welchii*, *Clostridium novyi* and *Clostridium oedematis maligni*.

12. Four other fatal cases of clinical gas gangrene developed at the same time in the same hospital. These cases were operated on within 4 days of the time at which the case we present was operated upon.

13. The chromic catgut in use in the operating room at that time yielded on culture *Clostridium novyi* in the hands of another bacteriologist and in our hands yielded

two strains of this newly described species, two different strains of hemolytic *Clostridium welchii* and two other non pathogenic spore forming organisms

14 The evidence seems to point toward chromic catgut, not properly sterilized as the source of organisms producing this series of fatal gas gangrene infections

15 These findings call for the establishment of adequate aerobic and anaerobic methods on the part of the manufacturers for the absolute demonstration of sterility of every batch of catgut put upon the market

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## ABDOMINAL SYMPTOMS OF HEART DISEASE, WITH SPECIAL REFERENCE TO THE RÔLE OF AURICULAR FIBRILLATION

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THERE are certain groups of patients suffering from cardiovascular disease who because of the predominance of abdominal symptoms often present themselves to a surgeon. In many instances the presence of heart disease has been recognized by the surgeon but he has not been fully aware of the frequency and variety of abdominal symptoms that may be secondary to certain purely cardiac affections. The syndrome called abdominal angina is well known and has been greatly clarified in recent years by the re-discovery of coronary occlusion as a clinical entity. Although the differentiation of abdominal pain due to the disease of the coronary arteries from that caused by some acute disturbance of the abdominal viscera is still not only difficult but at times impossible, the very recognition of the fact that the heart may be the cause of severe abdominal pain or even the picture of shock as often occurs in coronary occlusion, has meant a distinct advance in the solution of individual problems. When it is available, an electrocardiogram may help in establishing or excluding a recent ventricular infarction resulting from coronary occlusion. Children suffering from Henoch's purpura, with or without endocardial involvement, occasionally come first to the surgeon. In recent years I have seen two cases the first of whom was operated upon for acute appendicitis. It should also be borne in mind that in children nausea, vomiting, and abdominal pain may announce acute pericarditis. Attacks of paroxysmal tachycardia are occasionally attended by epigastric pain and, if the heart rate be not excessive, the determination of the underlying cause of pain may be difficult.

There is, however, a phase of cardiac pathology frequently seen by the surgeon the mechanism of which is much simpler than that involved in the groups previously

mentioned. It has to do with one of the functions of the liver—the capacity of that organ to act as a reservoir. Cardiac failure is still too often considered synonymous with gross edema of the extremities. In reality the most common sign of a failing heart is enlargement of the liver due to passive congestion and I submit as a corollary the most common cause of enlargement of the liver is passive congestion. Certainly failure to exclude passive congestion of the liver as the cause of abdominal symptoms has at times led to the performance of a laparotomy that had been better left undone. For example:

*CASE NO. 084.* This patient complained of epigastric pain, general weakness, loss in weight, cough at night and dyspnea on exertion. These symptoms were of 5 months duration. The heart was enlarged. The liver extended 5 centimeters downward. The lungs showed emphysema but no congestion. An X-ray examination of the gastrointestinal tract showed no evidence of disease. At a later examination there was no enlargement of the liver but because of loss in weight, anemia and epigastric distress the diagnosis of possible malignancy of the stomach was made and laparotomy was performed. A so-called chronic appendix was removed. The patient made a good recovery from the operation only to return to the hospital 1 month later with gross cardiac failure. The key to the diagnosis in this case was the decrease in the size of the liver after rest in bed.

A friend working in another clinic has given me permission to describe a recent experience of his.

Six days after tonsillectomy the patient developed cramp-like pains in the abdomen. He took purgatives without relief and returned to the hospital. He had pains in the joints but no limitation of motion. A diagnosis of mitral stenosis was readily made. The temperature was 102 degrees, the pulse rate 120 and the leucocyte count 19,000. There was tenderness and muscle spasm in the right upper quadrant of the abdomen and less marked tenderness in the right lower quadrant. At the first examination the liver was not palpable owing to muscle spasm. Laparotomy was performed at

once, and a normal appendix was removed. The following day, the liver edge was readily felt below the costal margin. Under salicylates and digitalis the patient became symptom free. The final diagnosis made was acute rheumatic fever, chronic valvular disease and chronic endocarditis.

Abdominal symptoms arising from congestion of the liver are more frequently seen in cardiac patients with auricular fibrillation. This may be defined as a disturbance of the cardiac mechanism in which the normal pace maker has been replaced by a rapid circus movement, which results in the cessation of co-ordinated auricular systole and in rapid, irregular ventricular beating. The evidence for the theory of the circus movement and the possible factors responsible for initiating this movement need not be reviewed here. Fibrillation may appear in any type of diseased heart, its pathology is entirely chemical and it is not related to any specific structural change. The heart lesions with which fibrillation is most often associated are mitral stenosis, the arterio-sclerotic heart, the thyroid heart, the hypertensive heart and, less commonly, the syphilitic heart. It may appear as a transient disturbance in the course of infection or as will be pointed out later, follow the stress of operative procedures. The establishment of the abnormal rhythm occurs instantly, that is in a time interval which only slightly exceeds that between two normal beats. Clinical recognition of this mechanism is almost always easy. The presence of auricular fibrillation is to be suspected in any irregular heart, beating at a rate of 120 or more. In untreated cases, there is almost always a disparity between the apex and radial rates. With the onset of fibrillation, co-ordinated auricular systole that is mechanically effective ceases, there is virtual auricular paralysis. Then there ensues distention of the great veins and backing up of blood in the liver, which acts as a reservoir. So completely may the liver compensate for the inadequacy of the pump by removing a large volume of blood from the general circulation, that these patients may show not only absence of edema but even no congestion of the lungs and slight or no cyanosis. The accumulation of blood in the

liver may occur so rapidly that the capsule is suddenly distended, producing acute pain in the upper abdomen. More commonly there follows chronic passive congestion of the liver and portal stasis. The usual purely cardiac symptoms, palpitation and dyspnea on exertion, may be relatively slight and even overshadowed by the abdominal symptoms—pain, swelling of the abdomen, nausea and vomiting or less definitely, indigestion or flatulence. That such a sequence of events might have a purely surgical aspect was first impressed on me some years ago when I saw a man who had been operated upon by a competent surgeon for supposed gall bladder disease. The gall bladder was found to be normal, and it was later apparent that the symptoms had been due to engorgement of the liver secondary to auricular fibrillation. These points may be illustrated by reference to a few cases.

CASE No 16.—The patient who was a salesman and did much walking had been in good health. Having just eaten breakfast, he stooped down to poke the fire and as he did so he experienced severe pain in the region of the liver. He was nauseated and vomited. The family doctor was called and said that the man had acute appendicitis. He was kept in bed for 3 weeks with ice on the abdomen. On resuming work he suffered from shortness of breath, cough and soreness in the upper abdomen. There had been no edema. He then came to the hospital and was found to have mitral stenosis with auricular fibrillation. The apex rate was 147 and the radial rate, 85. He showed moderate congestion of the lungs and a large and tender liver.

CASE No 253.—While working in a coal mine, this man was seized with severe abdominal pain, weakness and shortness of breath, so that he had to be carried to his home. He had always been well and strong and had worked in a coal mine for 20 years. He was sent to the hospital and admitted to the surgical service with a diagnosis of acute appendicitis. This patient also had mitral stenosis with auricular fibrillation. The liver was enlarged and very tender to pressure. There was no moisture in lungs, but deep cyanosis of the lips and fingers.

CASE No 324.—The patient's principal complaint was pain in the middle of the abdomen which came on suddenly while working as a laborer and had persisted for 7 months before he came to the hospital. There had been no edema and only a short time before he was seen, had he noticed shortness of breath on exertion. Auricular fibrillation was present. The liver extended to the umbilicus and was tender to pressure. After he had taken 24 cubic centimeters of tincture of digitalis, the

abdominal pain and gastric distress after eating entirely disappeared and the liver was no longer palpable

The following is an illustration of a more chronic type of portal stasis

CASE NO 121 This patient came to the hospital complaining of epigastric pain. The pain was not definitely related to the taking of food. Five months before he had been injured in a coal mine and 3 days later there developed swelling of the abdomen so that he was obliged to give up his work. Auricular fibrillation was found to be present with a large and tender liver. There was no cyanosis, no congestion of the lungs and no oedema. The apex and radial rates were 80. The gastric acidity was low. With a clinical diagnosis of peptic ulcer the man was sent for X-ray study. The obliging skiagrapher said he suspected an ulcer on the lesser curvature of the stomach which was probably malignant. The surgeon was persuaded to withhold operation and after the administration of digitals all symptoms disappeared.

It may be pointed out that in long standing cases of passive congestion of the liver associated with auricular fibrillation, with treatment the size of the organ may decrease but in many the liver remains large and can always be readily palpated.

On the other hand it is well known that some patients have auricular fibrillation for many years and even untreated remain quite free from symptoms. Thus fibrillation may appear in surgical patients in the role of an innocent bystander. For example

CASE NO 923 The patient was a coal miner who came to the hospital because of a contusion of one arm sustained at his work. He did not know of anything wrong with his heart. He had slight dyspnoea on exertion and cough with expectoration not unusual symptoms in a coal miner of 53 years. The heart was not enlarged. There was only slight elevation of blood pressure and there were no signs of congestive failure but auricular fibrillation was present.

Then there is the difficult group of cases of organic heart disease in which fibrillation may be present temporarily as the result of some added morbid process or the patient may have fibrillation permanently established for his cardiac mechanism and symptoms due to independent abdominal disease. Great care is required in these patients to establish the presence of unrelated diseases.

CASE NO 549 This patient who had suffered from flatulence for several years complained of epigastric distress then general abdominal cramps, nausea and vomiting and finally attacks of right upper abdominal pain so severe that morphine was required. He had had rheumatic fever in youth. The liver was enlarged and there were reasons for suspecting cirrhosis. Auricular fibrillation was present. A diagnosis of suppurative cholecystitis was made and under local anaesthesia one pint of pus was removed from beneath the left lobe of the liver and the gall bladder which also contained pus was drained. During convalescence the fibrillation ceased. One year later the man returned to the hospital to die of empyema. No recurrence of the fibrillation was observed.

CASE NO 46 For years the patient suffered from indigestion, flatulence and discomfort in the upper right abdomen. Finally he had attacks suggestive of gall stone colic but no jaundice. There was present at that time a cardiac irregularity which was later shown to be auricular fibrillation. The gall bladder was opened and drained and sand and small stones were found. Relief of indigestion and constipation followed. Thirteen years later the man died of cardiovascular renal disease. The auricular fibrillation persisted throughout this period.

The occurrence of auricular fibrillation as a postoperative complication is in itself an interesting subject. This disturbance of mechanism occurs most commonly following operations on the thyroid gland, but may occur in any type of heart disease. The disorder is usually transient. In my experience, I have never seen a patient who developed postoperative fibrillation who did not because of or in spite of the treatment administered revert to normal cardiac rhythm. It has been taught that transient fibrillation should not be treated with digitals. This teaching is based on the fact that both experimentally and clinically digitals may produce fibrillation. Accidentally or wilfully I have poisoned many people with digitals but only once have I seen auricular fibrillation result from excessive use of the drug. Many times I have seen fibrillation occurring in the course of pneumonia of thyroid disease, and after operation cease following the administration of digitals. It is my impression, though unfortunately the question does not lend itself to proof that the pre-operative use of digitals in patients with diseased hearts may guard against the development of auricular fibril-

lation is a postoperative complication. On a few occasions, the use of quinidine sulphate has been apparently successful in stopping postoperative fibrillation. One example will illustrate this phase of the problem.

CASE No 154. This patient was a woman 50 years of age who suffered from chronic valvular disease probably mitral stenosis. Previous to the operation electrocardiographic examination showed an arrhythmia due to auricular premature beats. It is well known that this disturbance often occurs as a forerunner of the more serious disorder fibrillation. On November 10, 1923, a stone was removed from the lower calyx of the left kidney both local and ether anesthesia being used. Following the operation 8 cubic centimeters of tincture of digitalis was given per rectum. On the morning of the following day the blood pressure was 120/80. The heart rate was 8 and an occasional premature beat was still present. The second day after the operation the picking was removed from the wound. This was associated with great pain. Shortly after this the nurse noticed a change in the pulse. Examination showed that auricular fibrillation had developed. The apex rate was 130 and the radial rate 118. The blood pressure was 115/80. That afternoon and evening three doses of quinidine sulphate 0.2 gram were given and sufficient morphine to secure rest that night. When examined the next noon the cardiac rhythm was normal and remained so during the stay in the hospital. On April 1, 1926 while she was stooping over when working in the garden fibrillation recurred and persisted until death which occurred suddenly in December 1926.

There is one other primary cardiac disease which I have found to have significance for the surgeon, that is subacute bacterial endocarditis. The diagnosis of this infection in the early stages before embolic phenomena have appeared, may be difficult. The problem here may be illustrated by the following case histories.

CASE No 1768. A woman of 52 years complained of dull pain and a sense of heaviness in the upper left abdomen and left side which at times was referred to the left back and to the precordial area. This pain had been present for about one year during which she had spent most of the time in bed. She had lost 60 pounds in weight. She ran in a regular temperature which often rose to 100 degrees. Anæmia was not marked and there was no leucocytosis. The presence of mitral stenosis with auricular fibrillation was readily diagnosed. There was slight enlargement of the liver and the spleen was readily palpated. The fingers at first showed raised and rounded nail bases, frank clubbing soon developed. On the left palm were two slightly swollen

round tender areas of reddish discoloration probably caused by bacterial emboli. And finally, the blood culture yielded streptococci. In this as in all cases described apparently the first diagnostic measure employed by the surgeon has been the X-ray study of the gastrointestinal tract. This procedure has always proved useless and always expensive. This patient's abdominal symptoms were due to splenic infarction and perisplenitis.

CASE No 187. A child of 13 years had been ill of heart disease for 1 year. For several weeks she had had fever. She was suddenly seized with severe cramp like pains in the center of the abdomen accompanied by nausea and vomiting. Morphine was given and the child was brought to the hospital. There was general abdominal rigidity which could be overcome by pressure to a certain extent. Tenderness to pressure appeared most pronounced in the left hypochondrium. The heart showed enlargement and a systolic murmur. The leucocyte count was 2,000. The following day the surgeon thought that the tenderness and rigidity were more definite over McBurney's point and a laparotomy was performed. A normal appendix was removed and the gall bladder was normal. Convalescence was normal for weeks when there was a return of the abdominal pain and of fever. The child had definite signs of mitral stenosis, frank clubbing of the fingers and slight clubbing of the toes. The spleen was not palpable and had not been examined at operation. The blood cultures were negative but there seems little doubt that the acute abdominal symptoms in this case resulted from infarction of the spleen.

CASE No 634. The patient was a man of 35 years in whom a diagnosis of subacute bacterial endocarditis had been fully established. He developed tenderness over McBurney's point and on this account laparotomy was performed. There was no evidence of inflammation about the appendix. The patient made a good recovery from the operation.

CASE No 24. The patient complained of epigastric pain and tenderness. He ran an irregular septic temperature. Aortic insufficiency was present. There was high grade anemia without leucocytosis. A diagnosis of subacute bacterial endocarditis was made by one physician but this was overruled because of the slow heart rate. The right costophrenic angle was opaque and the question of a subdiaphragmatic abscess was raised. Laparotomy was performed. No abscess was found but the liver was enlarged and there was a large infarcted spleen. The patient died 2 days after the operation.

In addition to the cases of congestive heart failure and of bacterial endocarditis, who have successfully withstood laparotomy, I recall three patients with coronary disease and true angina pectoris in whom the gall

bladder was drained or removed with benefit to the patient and a case of coronary occlusion who recovered from amputation of a leg which had to be done because of popliteal thrombosis. Such examples may afford comfort to the surgeon when patients suffering from severe heart disease present indications for surgical interference.

#### SUMMARY

Because of predominatingly abdominal symptoms patients suffering from primary cardiovascular disease frequently first seek relief from surgeons. These abdominal symptoms comprise two groups. In one the origin of the symptoms is purely reflex as the abdominal pain, nausea, vomiting seen in disease of the coronary arteries or acute inflammations of the heart. In the other there are secondary changes in the abdominal

viscera which are responsible for the symptoms. In this group symptoms dependent on acute or chronic passive congestion of the liver and portal stasis are common. They occur frequently as a result of auricular fibrillation and the impairment of the circulation dependent on the arrhythmia itself offers a ready explanation. Abdominal symptoms resulting from infarction of the spleen and perisplenitis occurring in subacute bacterial endocarditis have been observed and three patients in whom laparotomy was performed have been recorded.

Patients suffering from cardiovascular disease may develop any known abdominal disease but because of the frequency and variability of abdominal symptoms in purely cardiac cases the burden of proof is on the establishment of an independent pathological process in the abdomen.

## GALL BLADDER-STOMACH ANASTOMOSIS

## A CLINICAL AND EXPERIMENTAL STUDY

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**T**HE operation of gall bladder stomach anastomosis for relief of obstruction of the distal end of the common duct due especially to inflammatory conditions and carcinoma of the head of the pancreas has been accepted among surgeons for many years. The procedure is described in standard books on surgery. Some authors have gone to the extreme of recommending the procedure for relief of gastric ulcer with the idea of neutralizing the acid stomach secretion. No matter whether one does or does not consider the operation a good procedure it must be admitted that occasions will arise when the surgeon has no choice but to use it. Such a case came to one of us (J. W.) about 3 years ago. Because we were very much concerned as to the possible derangement of the physiology of the gastro intestinal tract we made several tests to determine the presence of any changes from the normal. Fortunately the patient who is a nurse cooperated with us to the fullest extent.

Mrs. E. R., age 37, gave a history of having had a cholecystostomy performed 3 years previously for relief of gall stone colic. Following this operation the gall bladder fistula failed to remain closed because of obstruction of the common duct. On several occasions the fistula became closed for a period of 3 or 4 days. During these periods the patient was in tensely jaundiced and suffered excruciating pain. With spontaneous opening of the fistula the bile would again flow freely to the exterior with cessation of the pain and disappearance of the jaundice. An operation was performed with the intention of reestablishing the continuity of the common duct. However, on opening the abdomen there was found such a dense mass of adhesions that it was considered inadvisable to attempt to trace the duct. A gall bladder stomach anastomosis was therefore performed. The patient made an uneventful recovery. Fifteen days after the operation an Ewald test meal was given and the contents recovered with a Rhus tube. Tests of the acidity of the contents were made at 15 minute intervals and the results were as follows:

	15 min	30 min	45 min	60 min
Total acid	0	30	36	14
Free acid	0	5	40	10

The laboratory technician reported bile present in all specimens except the first. A year after the anastomosis was performed the patient was again examined and much to our surprise no bile could be recovered from the stomach with the same tests used just after the operation. We were forced to conclude that with the gall bladder drainage into the stomach the inflammation causing obstruction of the common duct subsided sufficiently to allow the bile to flow through its normal channel. It is well known that an artificial channel will not function if the normal channel is patent.

It will be seen that there was no demonstrable derangement in the reaction of the gastric secretion following this marked alteration of the anatomy and this is not surprising if we consider the manner in which bile normally flows into the intestinal tract. Normally little or no bile flows into the duodenum during the fasting period or in the early stage of stomach digestion. The flow of bile is started when the food first passes from the stomach into the duodenum and reaches its maximum rate within a few minutes. Therefore it is only after stomach digestion is well advanced that bile will enter the intestinal tract. Apparently it is the passage of the food through the pyloric ring which stimulates the flow of bile. In anastomosing the gall bladder to the stomach nothing has been done to interfere with this sequence. Therefore bile should appear in the stomach only in the late phase of digestion.

In an attempt to answer some of the questions arising from a consideration of this operation we performed experiments on several animals. The principal points considered were the effect of the anastomosis on the



Fig 1 The liver and stomach with the gall bladder connecting the two The small white areas in the liver represent abscesses

acidity of the stomach the amount of bile present in the stomach during various phases of digestion the effect on the emptying time of the stomach and the incidence of gall bladder and hepatic infection

Our first investigations were made on dogs The same technique was followed with each animal used The common duct was severed and ligated The gall bladder was attached to the anterior wall of the pylorus at a freely movable area and a simple gastrostomy was made near the anastomosis to allow removal of samples of stomach contents Several control dogs with simple gastrostomies were also prepared A period of 6 weeks was allowed

for complete healing of the tissues before the various tests were made

We first made tests for bile in the fasting stomach It was present in small amounts in 4 of 6 dogs and was never present in the control dogs This is what one would expect since there is normally a slight flow of bile during the fasting period

During digestion bile was always present in dogs subjected to anastomosis In several tests the bile flow was greatest 40 to 60 minutes after the introduction of food In two tests the flow was greatest 60 to 75 minutes after digestion of food To test for bile 10 cubic centimeters of stomach content were

mixed with ammonium sulphate powder and 2 cubic centimeters of acetone were added. After the acetone came to the surface a drop of concentrated nitric acid was allowed to flow down the side of the test tube. The presence of bile was indicated by a green color in the acetone. It is quite important to use an accurate method of determining the presence of bile as color alone is a test is liable to lead one into error.

The emptying time was determined by introducing 300 cubic centimeters of gruel through the gastrostomy and withdrawing small specimens by means of a pipette until no more of the contents could be recovered. In the control dogs the stomach was empty at the end of 75 minutes. In the 3 dogs subjected to anastomosis there was a residue of approximately 50 cubic centimeters after 75 minutes, in 2 of these dogs the stomach was empty after 1 hour. The retention of 50 cubic centimeters in 3 of the dogs was probably due to a slight mechanical obstruction formed in making the anastomosis or gastrostomy.

The results of the tests for acidity showed little difference between the controls and the dogs subjected to operation, our findings in the case reported being thus confirmed. With 300 cubic centimeters of gruel as a test meal (gruel was used because of the ease of putting it into the stomach) the free acid was 0 to 5 degrees in the controls and 0 to 10 degrees in the dogs subjected to anastomosis. The total acidity was 15 to 35 degrees in the latter. There was apparently a slight decrease in acidity in late stomach digestion in the dogs operated upon, but this was not marked enough to warrant any conclusions.

In the few tests made for its determination pepsin digestion was found impaired by the anastomosis. The Metz pepsin test with 24 hour incubation showed 12 to 15 millimeters digestion in 4 dogs. A control test showed 2 millimeters digestion. This observation is not of much value as only one control test was made.

All of the dogs gained in weight following operation. They seemed normal and in no way differed from normal dogs in their appearance.



Fig. The microscopic changes in the liver

It is evident from these observations that the physiology of digestion in the animals was little disturbed. We have demonstrated that the bile is not appreciably mixed with the gastric juice at any time. The probable explanation of this failure of the two secretions to mix is that the bile while passing through the stomach follows a definite channel and therefore does not mix with the stomach secretion. That the bile does neutralize the acid secretion when the two are mixed was very definitely shown in the appearance of the skin next to the gastrostomy. In preparing the animals the gastrostomy was made adjacent to the gall bladder stomach anastomosis. In these dogs the skin adjacent to the gastrostomy remained normal, but in the control dogs the skin was strongly corroded by the action of the unaltered acid secretion.

After several months the dogs were killed and examination was made of the abdominal organs. The findings were uniform in showing inflammatory thickening of the gall bladder and numerous abscesses in the liver near the gall bladder. The occurrence of these abscesses in dogs following gall bladder stomach anastomosis has been previously reported by Lehman and by Mann. If this result follows anastomosis in the human, the operation is of course not to be considered except in cases in



which bile flow from the liver to the gastrointestinal tract cannot be established in any other way (Fig. 1).

It was suggested by Dr. Eggers that possibly the difference in type of food particles found in the stomach of man and in the stomach of the dog might make a difference in the susceptibility to infection. In the dog the food consists of coarse particles which are not as extensively attacked by the bacterial stomach secretion as the more finely divided food in the human stomach would be. We decided that the monkey, whose manner of digesting food rather closely resembles the human process, would be an ideal animal on which to test this supposition.

An anastomosis was accordingly made in a monkey in the same manner as that described for the dogs. The animal remained in good

health for 8 months and at the end of this period it was killed for examination of the gall bladder and liver. There was neither gross nor microscopic evidence of inflammation in the gall bladder. The liver showed no abscesses. The only evidence of pathology in the liver was a moderate fibrosis and lymphocytic infiltration around the portal radicals near the gall bladder. The photomicrograph is from an area showing the most marked degree of inflammation in the liver of the monkey.

It is possible that we have here an explanation of the discrepancy between the clinical and the experimental results. But the one experiment with the monkey is not sufficient evidence upon which to base a conclusion and further investigation should be made in order to clear up this point.

## OVARIAN PREGNANCY

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ALMOST everyone who has written on ovarian pregnancy has attempted to analyze the literature on the subject. In consequence we have many divergent opinions as to the relative frequency of the condition. The latest to report such a case to date is Vineberg, who from a study of the recent literature accepts 56 cases which he considers authentic up to September, 1926. This figure is at variance with that of Dorsch of Wuerzburg, who collected 92 cases acceptable to him up to 1911. Sutton, on the other hand, claimed that only 48 cases were authentic up to July, 1924, including the one he reported. Whether any of these statistical studies represents the true status of ovarian pregnancy or not, all of the contributors agree at least that the condition is so rare and so interesting that each additional case observed should be recorded. Since Sutton's article at least 14 additional case reports have appeared in the literature indicating either that the condition is becoming more

frequent or that the cases observed are being placed on record with greater regularity.

Webster's claim that the fertilized ovum can develop only on muellerian tissue has not been borne out by the experience of the past few years. The majority of observers believe that the ovarian gestation is usually found in a graafian follicle and not necessarily in muellerian tissue. In support of this view is the frequent presence of lutein cells in the walls of the ovarian hematomata. The presence of a true decidual reaction is not held necessary for the implantation of the ovum. That the ovum may also implant itself in the ovarian stroma independently of the graafian follicle is illustrated by Sutton in the 12 authentic cases considered by him representative of extrafollicular implantation of the ovum. The criteria upon which the diagnosis of ovarian pregnancy is based were outlined by Spiegelberg in 1878 and have been universally accepted. The case which we report below (exhibited before the Chicago Gynecological Society) is one of the few cases of ovarian pregnancy which we have observed.

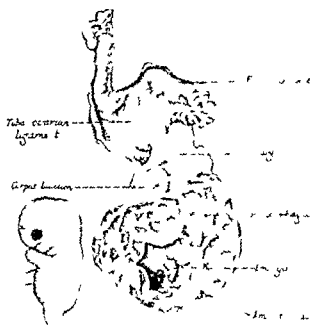


Fig 1 Ovarian pregnancy. Drawing made from postmen in authors' case.

logical Society on February 15, 1927) answers all of the requirements of Spiegelberg's specifications, namely:

- 1 The tube on the side of the pregnancy must be intact.
- 2 The fetal sac must occupy the position of the ovary.
- 3 The ovary must be connected with the uterus by the utero ovarian ligament.
- 4 Definite ovarian tissue must be found in the wall of the sac (in several places according to Williams).
- 5 The embryo must be visible in the cavity of the gestation sac.
- 6 There must be placental tissue within the ovarian stroma.
- 7 The tube must not only be intact, but free from any evidence of gestation.

#### CASE REPORT

Mrs. M. J., age 29, married 7 years, had 3 children, the eldest 6 and the youngest 3 years of age. She had one induced abortion a year ago. She was admitted to the surgical service of Michael Reese Hospital with the diagnosis of acute appendicitis at 2 a.m. September 12, 1926. She walked into the hospital. The complaint was abdominal pain which had developed suddenly during the day at first being diffuse over the whole abdomen and at the time of admission settling in the right lower quadrant. There was a history of nausea and vomiting with the onset of the attack. The admission tem-



Fig. 2 Chorionic villi in ovarian pregnancy. Necrotic corpus luteum. X60.

perature was 100 degrees F., pulse 98, respiration 20, white blood count 10,000.

Inquiry into the menstrual history revealed the fact that her last normal period was July 9, 1926. In August when the menstrual flow did not appear as expected she took Emmenagogue pills after which she flowed scantily for about 2 weeks. The September period had not arrived at the time of her admission.

On the basis of this history coupled with the fact that the tenderness and rigidity were quite marked low down on the right side, the possibility of an ectopic pregnancy was considered, and one of us (Stein) was asked to see her in consultation.

At this examination about 8 hours after her admission the tenderness and rigidity of the lower abdomen and pelvis prohibited the palpation of the uterus and adnexa, and the probable presence of a low grade postabortal pelvic infection was considered. The temperature was then 99.4 degrees F., pulse 90, white blood count 12,000, hemoglobin 65 per cent, red blood cells 3,500,000, and sedimentation time 1 hour. Cervical smears were negative for gonococci. It was decided that the condition of the patient warranted expectant management in the hospital with close observation. Two days later when the rigidity disappeared a definite mass could be palpated to the right and posterior to the uterus and the patient began to flow moderately, the bleeding continuing 5 days simulating menstruation. She now complained of no pain. The hemoglobin was 75 per cent, white blood count 9,000, and sedimentation time 55 minutes.

During the 2 weeks that the patient was kept in bed under observation she apparently improved in every respect. Because of the persistence of the mass, however, laparotomy was performed September 25, 1926. A Pfannenstiel incision was made and when the peritoneal cavity was opened a quantity of dark blood was found. The pelvic



Fig 3 Chorionic villus showing preservation syncytial and Langhans layers  $\times 230$



Fig 4 Haemorrhagic extravasation of ovary with degenerative changes manifest in the chorionic villi  $\times 75$



Fig 5 Decidua like cell No true decidual reaction observed  $\times 150$

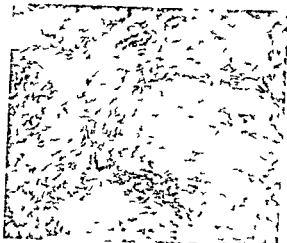


Fig 6 Normal ovarian stroma and corpus luteum observed in the area between the gestation sac and tubo ovarian attachment  $\times 75$

viscera were found completely buried by the densely adherent omentum and intestines. On the right side was a mass dark in color irregular in outline about 6 centimeters in diameter which appeared to arise from the right ovary. The tube was adherent to it but its fimbriated end was free. The opposite adnexa were also surrounded by adhesions so both were removed the tubes being removed by wedge shaped excision from the uterine cornua. Closure was effected without drainage.

The patient made a good recovery, complicated only by a stitch abscess in the fascial layer which was relieved by drainage. She was discharged from the hospital in good condition 27 days after opera-

tion. The specimen (Fig 1) is unquestionably an ovarian pregnancy. Grossly it consists of a fallopian tube 7 centimeters in length the fimbriated end of which is free. There is no marked tortuosity of the tube and there is no hemorrhage in it. The cut section reveals a small lumen and a thick gray mucosa. Attached to it by a short broad thick ligament is a mass 6.5 by 5 by 4 centimeters of which the pole nearest to the tube is undoubtedly ovarian tissue. The outer surface of it is pale gray firm and coarsely corrugated. This merges into a large hemorrhagic mass covered by a thin gray smooth membrane. Section through this mass reveals a small smoothly lined cavity 2 centimeters in diameter containing

a 10 millimeter fetus attached by a cord. The tissue surrounding this cavity is undoubtedly placental tissue containing a great deal of blood. Grossly it appears to be infarcted. At the border of this hemorrhagic mass adjacent to the area of tissue which can be identified as ovary there is a well defined recently formed corpus luteum about 5 centimeters long and 1 centimeter wide. The cavity containing the fetus is eccentrically located and is separated from the margin farthest removed from the tube by 0.75 centimeter of placental tissue. The opposite border of the cavity is almost in the center of the mass.

**Microscopic section.** Sections through the ovarian mass in a region farthest removed from the normal ovarian tissue show that the mass is made up of numerous chorionic villi in most of which two cell layers can be made out (Figs. 2 and 3). These villi are embedded in and surrounded by a large amount of extravasated blood. The outer margin of the mass is formed by a fairly thick membrane in which there has occurred some older hemorrhage in addition to the more recent one and has on the surface of it some necrosis and acute inflammatory exudate. Many of the villi are necrotic and have lost their cellular outline (Fig. 4). Scattered about are clumps of cells, the nuclei of which stain deeply and are eccentrically placed. The cytoplasm takes a faint eosin stain and is occasionally vacuolated. These cells are arranged more or less in a syncytial fashion and resemble decidual cells (Fig. 5) however their arrangement in some fields indicates that they possibly may be fused cells which have been desquamated from the villi. In other areas they seem to be in the process of forming villi so that their resemblance to decidual cells is only that of their gross microscopic appearance. Section taken from the base of the tumor and the adjacent portion of normal ovarian tissue shows that the hemorrhagic area is separated by a dense necrotic layer of cells which is richly infiltrated by leucocytes and is directly in contact with a thick layer of corpus luteum tissue composed of large pale staining polyhedral cells. The necrotic zone on closer examination is seen to be made up of corpus luteum cells. Beyond the corpus luteum rather dense but normal ovarian stroma containing a large number of blood vessels can be seen (Fig. 6). A section through the fallopian tube shows no evidence of tubal pregnancy. None of the sections examined disclose any

tissue resembling muellerian duct inclusions or so called endometrial inclusions.

Five months have elapsed since the patient was operated upon. Examination at regular intervals has shown the patient to be in excellent condition.

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## PRIMARY ABDOMINAL PREGNANCY

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THE origin of abdominal pregnancies has long given rise to speculation. We know that in some instances at least the ovum appears to be fertilized *in situ* for this is the most reasonable and likely explanation of ovarian pregnancies of which a number of indisputable cases are on record. But this further question arises: Are abdominal pregnancies outside the ovary always secondary in nature—that is, has the ovum developed to a certain extent in the tube and subsequently by tubal abortion or rupture been shed into the abdominal cavity, settled down where it fell and aided possibly by the blood clot accompanying it proceeded to develop *in situ*? Or is there such a thing as a true abdominal pregnancy in which the fertilized ovum, without residence in the tube or ovary to promote its start, settles down and develops for itself unaided by the presence of any surface into which it can readily sink?

A considerable number of cases are now on record which seem to support the hypothesis of primary abdominal pregnancy. Apparently the first of these was Galabin's case reported in 1896. While there seems a possibility in this case that a very early tubal abortion may have occurred, a careful study of the autopsy specimens by a committee of the Obstetrical Society of London resulted in a diagnosis of primary abdominal pregnancy. In Wittbauer's case published in 1903 the ovum was rolled up in a piece of omentum which was adherent to the pelvic organs. Hirst and Knipe in 1908, published a case which seems to meet all requirements. The case reported by Hammacher in 1910 is similar in many respects to the one we describe below. Other apparently genuine cases of primary abdominal pregnancy have been reported by Richter, Czyzewicz, Kohler, and quite recently by

Poten and by Mayer. In 1922 Jacquin of the Clinique d'Accouchement et de Gynécologie de Strasbourg gave an excellent review of the literature and cases up to that time. He admits the cases of Richter, Czyzewicz, Kohler and Walker as genuine and adds two more of his own and one seen by Schuckele.

While the evidence submitted in these cases seems to be convincing, there are some authors who still question the existence of this condition. Thus Schumann in his monograph on *Extra Uterine Pregnancy*, published in 1921 speaks as follows: 'No really authentic case of this variety which has withstood all criticism has been recorded.' Veit in 1903 reviewed the whole subject at the Congress de Gynécologie de Wurtzburg and came to the conclusion that exact proof of its occurrence had not been satisfactorily demonstrated. (Only two of the more questionable cases were then on record.) He subsequently revised his opinion somewhat and laid down certain very stringent criteria.

We believe that the following case is a true example of primary abdominal pregnancy. It not only fulfills the desiderata usually required but seems to present certain anatomical peculiarities which make it particularly convincing.

Hosp No 15862, a Chinese housewife 32 married, admitted to the Peking Union Medical College Hospital January 21, 1927. She gave a history of five pregnancies, the fourth being an abortion at 3 months. The other pregnancies all came to term, and the children are alive and well. The last labor had been 16 months before and she was still suckling the child. Four weeks ago she had a scanty menstrual period and 2 weeks ago a very light bleeding. At 9:30 a.m. on the day previous to admission she was seized with sudden intense pain in the lower abdomen, left side. Brandy gave some relief but the pain was still severe enough to keep her in bed. At 4:30 p.m. she had another intense attack



Fig. 1. Fimbriated extremity of the left tube closed by adhesions and cystic.  $\times 5$



Fig. 2. Section of tube and conception showing chorionic villi, blood clot and intact tube lumen.  $\times 8$

of pain collapsed and was taken to the Presbyterian Hospital.

At 7:30 p.m. consultation was sought from the Peking Union Medical College Hospital. The patient was then restless, grasping for breath and complaining of inability of vision. Blood pressure was about 50 systolic and she was pulseless and blanched. Since she appeared moribund it was thought best to do nothing in the way of radical treatment until she recovered from the profound shock. Seen at 8 a.m. on the next morning the patient appeared slightly improved though still pulseless and blanched. The blood pressure was 50-60 systolic and very difficult to determine though respiration was fairly regular and the patient conscious. An injection of morphine was given and she was transferred to the College Hospital by ambulance.

At 12 noon the patient was taken to the operating theater still pulseless with blood pressure about 60 systolic. Direct blood transfusion was begun by the syringe method and the abdomen opened. A large amount of clotted and fluid blood was found. The left tube was lying in normal position with a rupture on its superior surface about half way from the cornu to the fimbriated extremity which was however manifestly sealed and had apparently been so for a long time. There was no sign of recent inflammation about this portion of the tube and the left ovary was normal. The ruptured portion projected markedly from the surface of the tube which seemed to be affected over a smaller area than is usual. The reason for this was later made clear by the microscopic examination. The right ovary and tube were in place and in the distal portion of the ovary from the fimbriated extremity of the right tube there was a typical corpus luteum of pregnancy. The right tube was perfectly normal both as to size, shape, palpation and color and the fimbriated extremity showed no signs of inflammation either past or present. The

left tube and ovary were quickly removed, the abdomen sponged out and closed and the patient left the table with a perceptible pulse at the wrist 600 cubic centimeters of whole blood having been given.

Recovery was rapid and complete and the patient went home on the fourteenth day after the operation.

The Report of the Pathological Department on the specimen is as follows:

*Gross examination.* Specimen consists of a fallopian tube and ovary. The distal end of the tube is closed up and bound down to the surface of the ovary. There is a cyst in the ovarian ligament the wall of which is very thin. The lumen contains colorless fluid. In the middle portion of the tube is an artery which shows a reddish brown discoloration. The wall of the tube is broken at this part and the lumen is slightly distended and contains loose grayish brown material. Sections of the tube cut distally from this hemorrhagic area show that the lumen is closed up by grayish white solid tissue. There are several small cysts in the ovary.

Second specimen consists of an irregularly shaped piece of tissue consisting of small villi. This material had probably dropped out from the lumen of the tube.

*Microscopic examination.* The fimbriated end of the tube is sealed up by old adhesions and its epithelial lining forms several cysts which contain coagulated fluid. The lumen of the middle portion of the tube is very narrow and almost obliterated, its villi being bound together by old adhesions. Decidua and chorionic villi are found on the peritoneal surface of the tube especially in a pocket formed by the mesosalpinx and the mesovarium. This pocket was taken for the lumen of the tube which was described in gross as being broken. The loose tissue described in gross as situated in this pocket and represents chorionic villi and decidua. The lumen of the tube does not communicate with the sac although at one



Fig. 3 Section of tube and part of conception box showing chorionic villi blood clot wall and lumen of tube X 212

point the placental tissue is dissecting the wall of the tube and is found in close neighbourhood to the mucosa of the fallopian tube. Nowhere is there decidua found in the mucosa of the tube. There are several follicle cysts in the ovary. An organizing corpus luteum was found in the ovary.

**Diagnosis.** Chronic salpingitis with obliteration of fimbriated end of fallopian tube ectopic pregnancy formation of decidua and chorionic villi on the peritoneal surface of fallopian tube and in a pocket formed by the mesosalpinx and mesovarium follicle cysts in ovary organizing corpus luteum in ovary.

There were no signs about either tube or in the pelvis of the presence of endometriomata which might serve as a nidus for the ovum to occupy and it is at least unlikely that there was only one such nidus situated on the outer surface of the tube. The corpus luteum found in the left ovary was one belonging to a previous ovulation and was in a state of marked degeneration while there was no doubt whatever about the corpus luteum of pregnancy in the right ovary which was normal in appearance. Apparently the ovum having been fertilized in the abdomen and having failed to enter the only normal tube the right one wandered over to the left of the abdomen and failing to enter the left tube on account of its closed fimbriated extremity settled down on the outer surface of the tube and proceeded to embed itself. The sections of which many have been made show clearly that the lumen



Fig. 4 Section of tube and part of conception showing the pocket formed by the mesosalpinx and mesovarium X 8

of the tube is intact and that the ovum has embedded itself from without the tube. There is only one similar or possibly similar case which we have found on record namely one by Hammacher the place of attachment being the peritoneal surface of the right tube.

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# CLINICAL SURGERY

FROM THE OBSTETRIC CLINIC OF DR. BARTON COOK, HIRST

## THE BARTON OBSTETRIC FORCEPS

A REVIEW OF ITS USE IN FIFTY-FIVE CASES

BY CARL BACHMAN, M.D., PHILADELPHIA

University of Pennsylvania, May 1914

**T**RANSVERSE and posterior arrests of the head high in the pelvis have been perennial obstetric problems and their management a never ending source of discussion. That the mechanism of labor involved in these conditions is interpreted in hopelessly divergent ways is evidenced by the varying degrees of importance accorded the conditions as pathological or clinical problems in different localities, and the oftentimes acrimonious disagreement among proponents of various methods of delivery. Among those whose training or preference is in favor of forceps interference in suitable cases after reasonable test of labor, the two problems are frequently considered together. Here again, the conception of the primary fault—whether of rotation or descent—is mooted, advocates of various maneuvers differing as to the proper sequence for applying traction and rotation. For persistent posterior positions of the vertex, this clinic has, for many years, advocated and continues to recommend the Scanzoni maneuver with rotation deferred until the biparietal diameter has passed the bony outlet whatever the level of the original arrest—excepting those cases in which rotation has a tendency to occur spontaneously as traction completes the descent. For transverse arrests, however, particularly at the pelvic brim, there has long been need of a more suitable instrument than the classic forceps, especially in those instances in which effort has been made without success to alter the position manually into an oblique one before applying the forceps. An instrument with diminished or absent pelvic curve is here desirable—and the Elliott blade has in some clinics been utilized, even to the extent of manually changing all posterior arrests into transverse positions (4)—thus to apply the forceps and complete delivery without the reapplication imposed by the Scanzoni technique. However

frequently the need has been felt and means devised no practical solution has attracted the widespread attention achieved by Kjelland's instrument in the past decade abroad and more recently in this country (1, 2, 3). With the enthusiasm attending its successful trial in the transverse arrests for which it was presumably designed it has been used and recommended on more numerous indications judiciously or otherwise in face and even breech presentation. It is also recommended now for direct application to posterior as well as to transverse arrest.

To American obstetricians it should be of interest that an instrument was devised simultaneously and independently in this country by Dr. Lyman Barton, of Pittsburgh, New York, which circumstances prevented having the early and extensive trial enjoyed by Kjelland's idea but which from an experience in 55 applications in this clinic since April 1925 impresses us more favorably in its design and in its actual use. The Barton forceps differs from the classic types in that the blades join the shanks at an angle corresponding with that between the axis of the superior strait of the pelvis and the axis of the pelvic outlet. For purposes of application a joint is incorporated at the junction of the anterior blade with its shank, permitting the blade to be swung through an arc of a circle until it is nearly parallel with the shank. The limits of this arc of 90 degrees are controlled by a shoulder which automatically keeps the blade rigidly immovable on the shank when the instrument is applied. Like the Kjelland forceps, the instrument is provided with a sliding lock, but it is lighter in construction. Figure 1 shows a comparison of the two instruments drawn to scale. It will be noted from the drawings that there is no pelvic curve in the Barton blades (17). Lightness of construction, together with absolute flatness of the cephalic



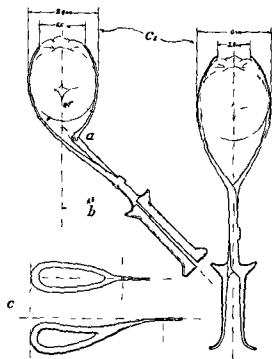


Fig. 1 Drawing of instruments drawn to scale

surface of the blades and absence of cupping in the cephalic curves permits an overall diameter of 9.4 centimeters as compared to 10 centimeters with the Kjelland blades applied to the same fetal skull having a biparietal diameter of 9 centimeters (c). The shape of the cephalic curves moreover provides for a more snugly fitting application to the same head in the case of the Barton blades with wide separation of the blade tips (c) more evenly distributed pressure over the cranium and less forceps flare in advance of the descending head.

*Extracts from a letter by Dr. Barton should be historically interesting.*

The purpose for which the instrument was invented was to construct a forceps that would be applicable to the biparietal diameter of the head in cases of arrest of the head at the pelvic brim without disturbing the relation of the head to the pelvic axis. I never saw or heard of the Kjelland forceps until several years after my drawings were made so I can scarcely say that they were designed as an improvement on that instrument.

As to original dates I would say that the idea of constructing a forceps with the blades at an angle to the shanks occurred to me over 20 years ago. A rather crude model was constructed and I had a conference with the late Professor Cragin of Columbia University in regard to this modification of the forceps. His opinion was that while the idea might be correct in theory it would not work out in actual practice. Acting on his advice I did nothing further with the forceps until 14 years ago. At that time I had drawings

of the perfected instrument and these were given to Professor Studdiford for his opinion. He agreed with Professor Cragin and consequently the project was again abandoned. In 1924 I exhibited a drawing of the forceps to Doctor A. D. Campbell of Montreal who at once appreciated the significance of the design and advised me to have the forceps made at once. The first pair was completed about the middle of October, 1924 and Professor Studdiford had in some way heard of it and asked me to show the forceps to him as soon as completed. During the Clinical Congress of the American College of Surgeons held in New York City in October, 1924 I exhibited them to both Professor Studdiford and Doctor Caldwell. Both were very skeptical as to their value but finally to settle the question they decided to see what could be accomplished with the manikin. Doctor Caldwell was the first to experiment with them and much to his surprise he found they were easy to apply and effective in delivery. The first actual case in which they were used was during the first week of December, 1924. They were exhibited at Sloane Maternity at a meeting of the American Gynecological Club in February, 1925. At that time I think they had been used in fourteen difficult cases. I have not heard from Doctor Caldwell in regard to their use at Sloane since December, 1926. At that time there had been 106 cases at that institution.

The following technique of application is recommended for deep transverse positions.

With the patient in the dorsal position under anesthesia the operator should first make an exact diagnosis of the level of the presenting part, the direction of the sagittal suture in relation to the pelvic diameters and the position of the fontanel. It will aid the beginner to visualize the desired application if the two parts of the forceps are articulated and the instrument held in front of the perineum. For all application the blades will naturally be in a line perpendicular to the sagittal suture and the hinged blade always uppermost. Note is made of the side on which the leading point (occiput in vertex, chin in face presentations) lies in order to know in which direction to rotate the head when the proper moment arrives.

Either the anterior or posterior blade may be introduced first but to avoid crossing the handle it is preferable to start with the anterior or hinged blade. It is likewise of little importance which hand is used to introduce the blade following the custom of most users of the Kjelland forceps the left hand is recommended as the vaginal hand for both blades. The index and middle fingers of the left hand are therefore introduced into the vagina and the posterior rim of the cervix sought. The handle of the anterior branch is then grasped lightly with the right hand and with the concavity of the blade directed toward the ceiling the blade is guided up the posterior wall of the vagina until the tip lies against the head in front of the promontory and within the rim of the cervix (Fig. 2). Rotation is then accomplished

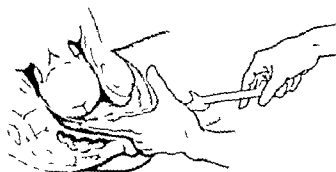


Fig. 1 figures 10 to 12 illustrate the steps in the application of the forceps

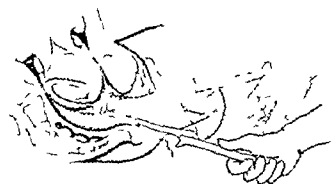


Fig. 3

with the fingers of the internal hand aided by gentle torsion of the handle in the right hand (Fig. 3). Here, again, it is of little importance to which side the blade is rotated whether over the occiput or across the face, but we prefer always to attempt it first over the occiput and in most cases this is readily achieved. There are instances, however, in which excessive molding of the occiput will make it easier to rotate across the face, and this may be attempted without fear of inflicting injury if the operator is reminded that in this, as in any forceps application, force is dangerous and should be unnecessary if the case be properly chosen. In occasional cases there will be temptation and perhaps justification for displacing the head slightly up out of the pelvis in order to complete an otherwise difficult application, but the danger of prolapse of the cord is as imminent here as with any instrument and the practice is not to be encouraged. It will aid in understanding the technique of rotation to appreciate that the arc described does not necessarily pivot around the hinge joint as a fixed point; the latter usually describes a coincident but smaller arc in an opposite direction as illustrated, the pivotal center being a short distance within the blade itself. The blade can also be coaxed gently around when necessary by altering the depth of its introduction. At the completion of this stage of the technique, the anterior blade will be along the biparietal line of the head just back of the symphysis in the vertical plane.

The second blade of the forceps is likewise introduced posteriorly, and because of the construction of the lock, always to the operator's left side of the first blade. The index and middle fingers of the left hand without withdrawal, again seek the posterior margin of the cervix, and with the right hand used to introduce this branch of the instrument posteriorly, the internal fingers guide the blade into place (Fig. 4). By raising or

lowering the handle of this branch, the blade will slide readily into place, escaping impingement upon the promontory. With heads of normal biparietal diameter, and in synclismus, the handles should lock exactly. Separation of the handles usually means an increased biparietal diameter, while lack of apposition in the longitudinal axis of the handles as a rule denotes either a small or synclitic head. Effort should be made to determine the latter point as well as the maintenance of the original transverse relation of the sagittal suture before withdrawing the internal fingers. When the head is synclitic, the application may be altered to meet the condition by raising or lowering the handles. Because of the sliding lock, however, the branches may be articulated even though the blades are not on the same level and with the first traction the blades will adjust themselves.

With the forceps symmetrically in place over the parietal bones of a transverse head, the blades are in the anteroposterior diameter. In occasional instances of tight engagement it may be justifiable to alter this exact application by placing the posterior blade slightly to that side of the promontory on which the leading point lies, and adjusting the anterior blade to fit opposite cases have been delivered thus when no other forceps maneuver was possible.

Before beginning traction, it will be noted that the handles point forward and downward, not in an axis continuous with the vertical or sagittal axis of the head, but at an angle deviating approximately 45 degrees forward from this line (Fig. 5). Traction therefore is *not* made in the direction of the handles, but in the axis of the child's head, or more strictly, in the axis of the pelvic canal at the level of the greatest diameter of the presenting part. The force applied is, therefore translated. It is made entirely with one hand grasping the shanks of the forceps firmly

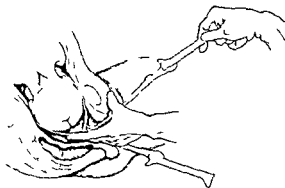


Fig. 4

near the hinge joint as shown. As an aid to this step an axis traction handle has recently been devised for attachment to the shanks. The other hand grasps the handles proper but very lightly and only to maintain apposition and to aid in guiding the forceps. The traction may be applied either by pulling or by standing to one side of the forceps just within the maternal thigh and pushing downward and forward in the required direction (Fig. 6). Tremendous power can be developed by the latter method, a fact of interest to those who may be skeptical of the adaptability of so light an instrument for difficult tractions. As the head descends there is a tendency to spontaneous rotation which should be followed and encouraged by altering the position of the handles to maintain the application in fixed relation to the scalp as it appears (Fig. 8). In cases in which spontaneous rotation does not occur the practice in this clinic is to bring the head to the outlet before attempting rotation, crowning of the scalp is usually well advanced at this point and if the direction of the pelvic canal has been properly

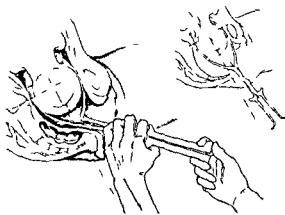


Fig. 5

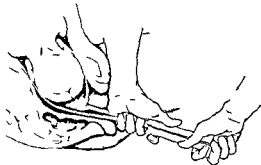
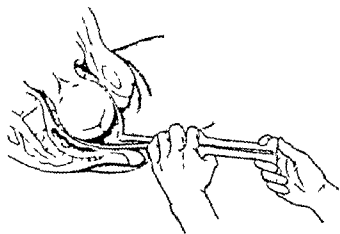


Fig. 6

followed the forceps handles will be slightly elevated. The elevation is not so great for corresponding levels of the birth canal as with the classic forceps and caution must be exercised as with the Kjelland instrument, not to lift the handles prematurely because of the danger of injuring the cheek or facial nerve with the anterior blade. During rotation of the head traction is greatly lessened but need not and should not be abandoned entirely. As the head rotates the handles will tend to swing upward and laterally over one or the other maternal thigh but the coincident extension and transit of the head through the vulvar orifice raises the blades simultaneously the terminal movement of the instrument thus being an upward roll in the so-called curve of Curus and the final position one of almost complete inversion with the handles inclined upward and transversely across a thigh (Fig. 9 see also Figures 10, 11 and 12).

While the teaching and practice of this clinic has long favored the Scanzoni maneuver for persistent posterior positions of the vertex the above technique for Barton application in transverse positions is equally applicable to posterior positions with the few obvious alterations necessary to bring the blades to grip on an oblique head biparietally and the extra degrees of rotation necessary to guide the leading point under the symphysis. Extraction is completed without re-application.

Our series includes the use of the Barton for cephs in 55 cases during the past 2 years in a total of approximately 900 inpatient deliveries at University Hospital. The applications were made by five members of the staff. The use of the Kjelland forceps in only 12 cases in the same period means that preference was given the Barton forceps when either forceps was indicated with the purpose of using the Kjelland instrument in just enough cases to reach some impression or judgment as to comparative value. The validity



Fig



Fig. 8

of the indications for forceps interference is attested in part by the average duration of labor for the series the same being over 24 hours including 6 elective applications and 33 multiparous labors. The forceps was, therefore subjected at once to the same tests and obstacles confronting any forceps maneuver there being 28 high applications and the group in any event not being a selected one. Note should also be made of the local practice of deliberately incurring 'errors of judgment' by attempting a trial forceps in all cases admitted from outside sources with obstructed labor or floating head (when the disproportion is not too obvious and when the cases are potentially or actually infected from manipulations prior to admission), the above being in many instances a routine preliminary to a promptly indicated cesarean section or craniotomy.

The results are tabulated under two classifications, applications to transverse (Table I) and to oblique positions (Table II), to form some idea of the usefulness of the instrument in conditions other than that for which it was strictly designed, and to compare it with both the classic and the Kjelland forceps in these instances. In each table the applications are listed as to 'arrests,' 'floating heads' and 'elective' applications, meaning simply the position and explanation therefore at the time of application. In case of transverse arrests, it is impossible to analyze the labor further as to the primary positions, some cases, therefore being transverse arrests of rotation from original posterior lies and others being arrests of descent from original transverse engagements in flat pelvis. A low transverse or posterior arrest is arbitrarily regarded as non-existent and therefore, is not listed. Simple Barton rotations without extractions are listed

separately but nevertheless as successful for cepts along with the complete maneuver since in all the former instances the extractions were completed by classic forceps from choice rather than necessity. Failures are catalogued as failed applications and failed forceps after successful applications. The failures are more illuminating than the successes, and several facts immediately are made clear.

The first is that despite the ultimate outcome and the bad obstetrics involved the Barton forceps is adaptable to floating heads, there being one failure in ten attempted applications.

For transverse applications we believe the instrument to be the safest and best designed for cepts yet devised. The two failures of application in this group were both errors of technique due to inexperience, one involving a prolapsed cord in a case of hydramnios with accidental displacement of the head during placement of the anterior blade. The latter accident is a more likely event with the Kjelland forceps, since disengagement of high heads is almost a necessity to permit introduction of the anterior Kjelland blade into the uterine cavity and its rotation therein.



Fig 9

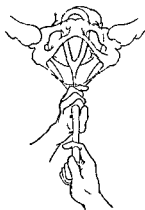


Fig 10



Fig 11



Fig 12

The light construction of the Barton blades and the wandering technique of application of the anterior blade make it not only a safer instrument than other types of forceps but widen its range of usefulness in borderline misfits and disproportions. The only unusual maternal injury of note in primumparous labors in the transverse group was a transient vesicovaginal fistula in a borderline case with a floating head. With the forceps once applied failure of Barton delivery was met in 3 cases out of the 34 in 2 of which the application was made with a certain prospect of failure craniotomy being necessary in one and cesarean section in the other. The remaining case delivered by classic forceps might have been managed with the Barton forceps after further familiarity. But taking inexperience and other conditions into account the facts are demonstrated that once applied the new instrument was successful in every instance open to forceps except one and that only one case in the series was delivered by other forceps after failure of the Barton forceps. The angulation permits traction in the true axis of the inlet (Fig 5) without interference with the pelvic floor or perineum and without soiling of the operator's hands by contact with the anal region. With the Kjelland forceps episiotomy is sometimes required to permit downward traction and contamination at the anus is difficult to avoid. This advantage of angulation is partly offset by the fact that the force applied must be translated requiring an accurate knowledge of the forces of labor. Caution moreover, is required to avoid too early elevation of the handles, and consequent facial injury by the anterior blade—a fault however applying equally to the Kjelland forceps. Although extraction of the head is readily accomplished with the

Barton forceps it is not as suitable for "scooping the head out" as an instrument with a pelvic curve. Even in this particular however we regard the more snugly fitting Barton blade as superior to the Kjelland with the latter's wide cephalic curve interposing considerable forceps flare and bulk in advance of the descending and emerging head and subjecting the soft parts to undue distention and strain.

A greater percentage of failed forceps occurred where the Barton forceps was used on oblique heads there being 5 such in 19 applications with 2 additional failed applications.<sup>1</sup> Three of the 5 failures were errors of judgment in that the cases were unsuited for any forceps. In spite of a local preference for the Scanzoni maneuver in persistent posterior occiputs the instrument was successfully used in 3 cases of occiput in the hollow of the sacrum showing that it is at least practicable in this ultimate evolution of failed rotation.

#### SUMMARY

From an initial experience with the Barton forceps we believe that there is a definite though limited field of usefulness for this instrument particularly in the rotation and traction of transverse arrests of the vertex in high and mid pelvis. It is the safest implement yet devised for these purposes and in some instances of impaction provides the only suitable or possible management. While its use in floating heads is not to be encouraged its adaptability to this problem is unquestioned and it will thus serve to increase the number of deliveries *per vias naturales* in these as well as in borderline disproportions. It has certain advantages over other instruments designed for the same purposes notably the Kjelland. It can be used to complete the extraction of the head, and it can be applied to oblique

TABLE I. BARTON FORCEPS TO TRANSVERSE POSITIONS

key		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Total	Primiparae	Multiparae	Deformed pelvis	Disproportion	Excessive dist. head	Average length labor in hours	Failed class forceps	Rotation and extraction	Rotation only	Total successes	Failed application	Failed forceps	Total failures
A	High Arrests	10	4	6	3	1	1	6	2	7	3	0	1	1	1
B	Mid Arrests	17	9	8	2	1	1	10	2	10	5	15	1	1	2
C	Floating Head	4	1	1	2	2	2	11	2	3	—	2	1	1	2
D	Elective	1	1	2	—	—	—	24	1	1	—	1	—	—	—
	Total cases	14	15	10	0	1	5	15	6	23	7	20	2	3	5

## Presentations

## Indication for Application

Arrest—Time Occiput persisting transverse

Military transverse

Deformed pelvis—Occiput transverse

Compound presentation

Inertia

Floating heads—Time

Elective—First of twins

Head presentation and twin

Demonstration to students

Vertex  
Military (A10)  
Vertex and hand (B19)17  
1  
120  
1  
2  
1  
4  
3  
1  
1

TABLE II. BARTON FORCEPS TO OBlique POSITIONS

## Posterior occiput

key		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Total	Primiparae	Multiparae	Deformed pelvis	Disproportion	Excessive dist. head	Average length labor in hours	Failed class forceps	Rotation and extraction	Rotation only	Total successes	Failed application	Failed forceps	Total failures
E	High Arrests	1	1	2	—	—	2	12	1	1	1	2	—	1	1
F	Mid Arrests	6	3	1	—	—	2	27	2	3	1	4	1	1	2
G	Floating Heads	6	2	4	2	1	2	32	—	1	1	4	—	2	2
H	Elective	3	—	1	—	—	—	13	—	3	—	3	—	—	—

## Anterior occiput

key		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Total	Primiparae	Multiparae	Deformed pelvis	Disproportion	Excessive dist. head	Average length labor in hours	Failed class forceps	Rotation and extraction	Rotation only	Total successes	Failed application	Failed forceps	Total failures
I	Mid Arrests	2	1	1	1	1	1	30	—	—	1	1	1	—	1
J	Floating Heads	1	—	1	1	—	1	36	—	—	—	—	—	1	1
	Total cases	21	7	14	4	4	8	25	3	8	6	14	2	5	7

## Presentations

Vertex  
Vertex and hand (G9)20  
1

Floating heads—Time

Compound presentation

Inertia

Elective—Abruptio placenta

First of twins

Demonstration to students

Arrests—Time Indications for Application  
Rigid soft parts Occiput persisting posterior of  
Inertia  
Occiput in hollow of sacrum  
Disproportion2  
1  
4  
3  
15  
1  
1  
1  
1  
1

as well as to transverse positions but, although superior to the Kjelland in both respects, it is inferior to the classic forceps with full pelvic curves. Its chief advantage from the standpoint of design, the angulation of the blades, is also its

chief disadvantage in unskilled hands, requiring a more accurate knowledge of the mechanism of labor to develop the proper direction of traction and to avoid facial injury with the hinged blade.

Concerning its usefulness outside of hospital practice indications will probably be few without extending them beyond the rather narrow limits here recommended. In hospital practice, local preference will in some quarters decide, as with the Kjelland instrument the advisability of adding a new instrument of restricted versatility to the established armamentarium. We believe that a further and more universal trial will win it many adherents.

TABLE III—BIRTH INJURIES

Type	No. of Cases	Cause	Result
Facial palsies (all transient)	6	Anterior	3
Forcep abrasion	12	Posterior	11
Forceps bruises	8	Posterior	5
Cephalhematomata	2	Posterior	
Intra cranial hemorrhage	1	Posterior	

TABLE IV—INFANT MORTALITY

1. A13 See failure 3. Intrapartum. Asphyxia ( )
2. A13 See failure 10. Intrapartum. Asphyxia and birth injuries
3. A13 See failure 11. Intrapartum. Asphyxia ( )
4. B9 O para aged 26 years. Normal pelvis. Labor at 36 weeks. Occiput right posterior. Failed forceps before admission. Infant died on admission. Cause of death: Asphyxia. Intra cranial hemorrhage not confirmed at autopsy.
5. B9 O para aged 26 years. Normal pelvis. Uterine placenta at 38 weeks. Manual dilatation cervix high. Barton application to occiput right posterior. Rotation and extraction. Intrapartum. Ixanguination. Asphyxia.
6. B9 O para aged 3 years. Normal pelvis. Placenta previa in twin pregnancy at 31 weeks. Manual dilatation cervix high. Barton application to second twin. Rotation and extraction. Neo natal Ixanguination and prematurity.
7. A10 O para aged 2 years. Normal pelvis. Labor at term. Admitted with prolapsed cord and hand. High Barton application to occiput right posterior. Rotation. Denees extraction. Intrapartum. Asphyxia.
8. B9 O para aged 27 years. Normal pelvis. Pulmonary tuberculosis in no prenatal care. Admitted in labor 17 hours at 34 weeks with accidental hemorrhage. Occiput transverse in mid pelvis. Barton rotation and extraction. Neo natal Ixanguination and prematurity.
9. F10 O para aged 16 years. Normal pelvis. Illegally pregnant. Labor at term. Occiput in hollow of sacrum after 12 hours. Easy rotation and extraction after failed Simpson forceps. Intrapartum. Asphyxia.
10. A10 O para aged 19 years. Justimom pelvis. Dry labor at 38 weeks. High transverse impaction of military presentation after 48 hours. High Barton rotation. Denees extraction. Intrapartum. Intracranial hemorrhage.
11. B9 O para aged 19 years. Flat pelvis. Admitted in labor 48 hours at term with occiput left transverse at rest in mid pelvis. Failed forceps before admission. Morphine administered one hour before delivery. Easy mid pelvic Barton application. Rotation and extraction. No apparent injuries. Heart beating at birth but no respiratory efforts. Neo natal Asphyxia (narcosis).

# FAILED APPLICATIONS AND FAILED FORCEPS

1. B12 O para aged 21 years. Normal pelvis. Late toxemia. Labor at 38 weeks. Occiput right posterior. Primary inertia. Occiput persisting transverse in mid pelvis after 40 hours. Infant weight 3 240 grams. Failed application. Delivered by manual rotation and Denees forceps extraction.
2. C12 O para aged 32 years. Normal pelvis. Late toxemia. Labor at term. Hydramnios. Myomectomy. Head floating after 23 hours. Infant 3 210 grams. Attempted application resulted in prolapsed cord. Delivered by immediate podalic version (Error technique).
3. A13 O para aged 3 years. Justimom pelvis. Two previous forceps deliveries. Late toxemia. Labor at 44 (?) weeks. Occiput right posterior. High pelvic arrest with occiput transverse after 13 hours. Disproportion. Infant weighing 4 200 grams. Failed forceps before admission. Fetus dead on admission. Failed forceps. Delivered by craniotomy. (Deliberate error judgment.)
4. B12 O para aged 18 years. Normal pelvis. Previous forceps delivery. Labor at 37 weeks. Occiput right posterior. Occiput persisting transverse in mid pelvis with cervix dilated 3 hours. Failed forceps. Delivered by oblique application of Denees forceps.
5. C13 O para aged 42 years. Flat pelvis. Previous forceps delivery. Labor at 39 weeks. Occiput right transverse floating after 28 hours. Disproportion. Infected. Failed forceps. Delivered by cervical caesarean section. (Deliberate error judgment.)
6. F12 O para aged 27 years. Normal pelvis. Labor at 37 weeks. Occiput right posterior. Occiput persisting posterior in mid pelvis after 16 hours. Infant 3 830 grams. Failed application. Manual rotation. Simpson extraction.
7. B12 O para aged 16 years. Justimom pelvis. Labor at 41 weeks. Occiput left posterior. Primary inertia. Mid pelvic arrest after anterior rotation. 56 hours in labor. Infant 2 904 grams. Failed application. Delivered by Denees extraction and episiotomy.
8. B13 O para aged 40 years. Irregular forceps delivery. Labor at 41 weeks. Occiput right posterior. Primary inertia. Rigid cervix (cicatrices). 2 hours. Forceps applied with cervix incompletely dilated and effaced. Spontaneous delivery 6 hours later. (Error judgment.)
9. F13 O para aged 31 years. Normal pelvis. Labor at 41 weeks. Occiput right posterior. Occiput persisting posterior after 60 hours. Failed forceps. Delivered by manual rotation. Mid pelvic application of Denees forceps. Episiotomy and extraction.
10. C13 O para aged 35 years. Normal pelvis. Labor at term. Occiput right posterior. Head floating after 16 hours. Disproportion. Infant weighing 5 475 grams. Engagement and high rotation by Barton but further traction ineffectual. Denees axis-traction to complete extraction. (Error judgment—caesarean section indicated.)
11. G13 O para aged 24 years. Increased pelvic inclination. Late toxemia. Labor at 42 weeks. Occiput right posterior. Head floating after 68 hours. Infected. All types of forceps unsuccessful. Infant viable. Cervical caesarean section. (Deliberate error judgment.)
12. B13 O para aged 32 years. Previous version. Increased pelvic inclination. Labor at 39 weeks. Occiput left anterior. Head floating after 36 hours. Infant 1 685 grams. Failure to secure engagement with Barton. Delivered by podalic version and after coming head forceps.

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## FROM THE ORTHOPEDIC HOSPITAL OF VIENNA

## OPERATIVE CORRECTION OF CLAW-FOOT

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**A**MONG the various foot deformities claw foot occupies a unique position. It is the opposite of flat foot in that all the signs and symptoms are exactly the reverse of those seen in flat foot. The calcaneus is vertical, the tuberosity of the calcaneus looks downward and as in the Chinese foot deformity the arching of the foot is intensified by a curve of short radius. The heads of the metatarsal bones appear nearer the tuberosity of the calcaneus, the length of the foot is essentially shortened and the tarsal joints are contracted to the claw shape which gives the deformity its name.

After a considerable length of time the bones naturally adapt themselves to the situation and the joints change accordingly, the musculature and ligaments in their functions likewise depending on these changes or if we wish so to express it the changes in the function of the musculature and ligaments serve as the original activating cause of these changes in the foot. Changes of equilibrium of the muscles of the foot and of the lower part of the lower extremity are the fundamental causes in this deformity.

The most severe cases are congenital. The cause is usually myelodysplasia, a derangement of development of the lower segments of the spinal cord, where the nerve cells controlling the musculature of the foot are located. This deformity frequently manifests itself as spina bifida, the delay of closure of the canal of the spinal cord.

Other derangements of the central nervous system such as syringomyelia and multiple sclerosis result in talipes cavus. Other types of paralysis of the peripheral nerves may produce this deformity.

Not infrequently we observe a lateral deviation of the foot, a pes valgus or more often a pes varus. These directional deviations from the normal are particularly apt to occur when talipes cavus is not pronounced. In these cases it is possible quite often with a mechanical apparatus or a corrective shoe to obtain partial relief without operation.

If the lateral deviations increase but without a pronounced talipes cavus and so without marked discomfort, it is possible to correct the condition by transferring the muscular control. This is done by means of tenoplasty, muscular equilibrium

being restored by transplanting the muscles and tendons which control function from the inner to the outer side of the foot or vice versa.

When the talipes cavus becomes very marked the contractions in the tarsal joints are very noticeable. The heads of the metatarsal joints drill holes in the sole of the foot. The massive shoe sole causes painful calluses which interfere with locomotion.

The pain and handicap in walking cause the patient to seek relief. Our old textbooks recommend manual correction for the deformity. Many types of apparatus have been devised to throw constant pressure on the instep of the foot in order to flatten down the extreme high arch.

Anyone who has tried to reduce a typical hollow foot knows that the contracting force required is enormous. The overcorrecting force is so great that the leverage action would crush the bones; indeed the operation is a very bloody one although no incision of the skin is made.

During the first trial at correction we are impressed with the fact that the fascia plantaris and the deeper portions of the muscles are at the highest degree of tension. The subcutaneous division of the fascia plantaris and the subsequent cutting of the flexor brevis muscle do not lead to the desired result. A remarkably powerful resistance can still be noticed. Added to that is the danger of rupture on account of shortness of the skin of the sole of the foot especially when its continuity has been weakened through a tenotomy wound.

For these cases of severe talipes cavus I have therefore devised an operation which satisfactorily fulfills the above requirements and avoids the dangers mentioned.

## TECHNIQUE

A semilunar incision which would correspond to the upper brim of a slipper ('slipper incision') is made 3 centimeters above the sole of the posterior half of the foot. The incision is started at the height of the arch on the inner side and ends at the tuberosity of the fifth metatarsal bone. Next the entire flap is dissected off with the underlying soft tissues from the heel. At the point of its insertion, the fascia plantaris is removed with





Fig. 1a (left) High degree of claw foot (spina bifida imperfecta) before operation

Fig. 1b The right foot was operated on 8 months ago while the left foot was operated on only 3 months before taking the photo

a chisel and the flexor brevis muscle is then severed from the os calcaneus

Now the entire flap which comprises the skin of the sole of the foot the subcutaneous tissues the fascia plantaris the flexor brevis muscle and also the abductors of the toes and the musculus quadratus plantae are bluntly dissected from the bony surface of the calcaneus and distally (anteriorly) retracted

The points of danger to be avoided are first of all injury of the posterior tibial artery. With great care during the preparation of the flap this can be easily avoided by working more on the inner side. The vessels the posterior tibial artery with its two terminal branches the internal plantar artery and the external plantar artery run on the surface of the musculus flexor brevis and the musculus quadratus plantae. Therefore if the flap is turned carefully to the inner side where the vessel passes the inner edge of the foot and the entire separation of the flap from the inner side is avoided no injury will be done to the posterior tibial artery.

However should it happen that during the exposure of this area of operation injury is not successfully avoided ligation of the posterior tibial artery will not cause severe consequences. The arteries of the heel provide such a rich blood supply to the sole of the foot that any disturbances of nutrition are prevented. In no case of injury to the artery followed by its ligation have we ever found any serious postoperative derangement of nutrition.

Proceeding with the operation we look for the tendon of the musculus peroneus longus the tendon being tightly attached to the bone. The flap is separated and removed by blunt dissection an operation which can be easily carried out after the insertion of the fascia plantaris has been chiseled off. The long plantar ligament which can be seen in the bottom of the field of operation is diagonally incised. External to this lies the



Fig. 2a (left) High degree of claw foot (Before operation)

Fig. 2b Three months after operation of right foot

calcaneonavicular plantar ligament which has to be definitely dissected like the calcaneocuboid ligament between the navicular and cuboid bones.

After these steps in the operation we try to redress the foot and are surprised to find that there is still considerable resistance. And it is only after all the ligaments under tension have been cut that the tension is relieved and the foot is brought into proper position. The length of the foot is now increased about 3 centimeter the point of insertion where the chiseling was done tilts forward about 3 centimeters and the calcaneus can be placed in a horizontal position if the ligaments which really held the calcaneus in the perpendicular position were separated.

When the correction is successfully completed the flap is replaced. It is now clear why the heel incision had to be made so high up since otherwise the incision would have been too near the sole of the foot and the edges would have gaped backward at the heel about 2 centimeters and later even under the most successful care granulation would have occurred and no shoe could be worn without pressure on the scar.

However if the incision is made high on the back of the heel and there is great tension a lateral union of the integument of the lower leg will take place and no gaping will result.

In every case powerful big biting stitches should be taken.

In severe contracted claw foot with hammer toe if the toes still show marked deformity after the operation described the tendons of the extensor longus digitorum and other extensors of the foot are transplanted from the toes to the metatarsal heads. In two incisions the tendons of the extensors are exposed and freed and the extensor hallucis longus transfixed to the first metatarsal and the tendons of the extensor longus digitorum (communis) on the third metatarsal head. The sutures placed either percutaneously



Fig. 3 Plaster casts before and after operation

or circularly around the metatarsi hold the tendons embedded in the fissured periosteum.

With my elevators, which have eyes, the sutures can easily be led around the bones. To perforate the bones for perosseal sutures I use drills which I have adapted from the ivory carving trade. They are more or less slightly curved hollow sounds which can be used as drills or perforators. The steel has to be hard and resistant and yet must not be fragile. Since these instruments were designed originally for drilling ivory and for carrying wires within elevators for perforating ivory, they are very practical for use in human bones which are considerably easier to manage. These drills or perforators have a trough like groove through which a suture on a needle can be pressed, so that with them tenoplasty can easily be performed.

If in the first stage of the operation the posterior tibial artery has been injured and ligated, in the second stage we have to be very careful. Extreme care has to be exercised not to injure any blood vessels for even with perfect knowledge of the distribution of the blood vessels on the dorsum of the foot, they might be easily injured as they run plantarward between the two heads of the first dorsal interosseous muscles (between the first two metatarsi). Such injury would produce marked necrosis and gangrene.

The wound is closed with catgut sutures and an immobilization splint carefully applied. The splint gives sufficient support for correction; therefore I lay special stress on the dressing of the operative area. I use overdressings of gauze and over that a hard thick cardboard sole against which the easily manageable foot is now immobilized. With a roll of gauze the region of the metatarsal



Fig. 4 Technique of operation

tarsal heads is elevated to the natural arch and another roll of gauze is placed over the toes. Another piece of cardboard well padded 2 to 3 centimeters thick is placed over the toes and secured so as to hold the toes in plantar flexion. The whole is covered with a plaster of Paris spica which reaches almost to the flexed knee. After 4 weeks of rest the cast is removed. The desired correction was obtained in every one of our cases as can be seen in the pictures of the plastic models.

For after treatment walking exercises of weight bearing are encouraged in which the important feature is the rolling off practice of the foot. These exercises consist of the patient standing up on the heel and gradually rolling off the foot toward the metatarses. With the assistance of the flexor hallucis longus the big toe is pressed down to the ground through which a completely normal rolling motion of the foot is obtained. Compare this with the previous claw position when the toes only partially and with their tips instead of the plantar surface of the first and second phalanges took a share in the action. Massage of the lower limb and the extensors of the foot complete the treatment.

Under supervision for many years the observations prove that the corrections are successful and the results have shown the operation to be perfectly reliable. No braces are employed but shoes with very thick, strong flat soles. The patients are directed to place shoe trees in the shoes at night in order that the flat surface of the shoe sole shall be preserved and the tendency of upward bending of the tip of the shoes prevented, as this favors the claw foot formation which is to be avoided.

The operation in the above described proceeding was performed for the first time in 1922 and resembles only in the first stage the technique of Stendler, but the original technique was already introduced at my hospital during the war, when there was no communication of reports existing.

# COMPLETED ASEPTIC TECHNIQUE FOR THE IMPLANTATION OF THE URETER INTO THE LARGE BOWEL<sup>1</sup>

By ROBERT C. COFFEY, M.D., F.A.C.S., PORTLAND, OREGON

In the May 1925 issue of *Northwest Medicine* I published a paper entitled "A Technique for Simultaneous Implantation of the Right and Left Ureters into the Pelvic Colon Which Does Not Obstruct the Ureters or Disturb Kidney Function" and I sent reprints of the article to members of some of the special surgical societies. The new feature of this operation was the fastening of rubber tubes in the ureters for the purpose of maintaining a patent canal for the passage of the urine through the traumatized intestinal wall during the first few days of convalescence. The first operation by this method was done on a patient with dilatation of both ureters as a result of cancer of the bladder and uterus. The advantages of the technique seemed apparent to nearly all surgeons who received the reprint. However in this case the condition was very far advanced, radium in large doses and two major abdominal operations were necessary so it was not a perfectly fair test. Two weeks after operation the left abdominal incision broke down and a large quantity of pus was discharged; nevertheless clear urine was freely discharging from the rectum. About months after

the operation the patient died of exhaustion with clear urine still coming from the rectum up to the time of death. Postmortem examination showed that the right kidney was normal. The left kidney was filled with miliary abscesses which seemed to be an extension of a process which had originated at the opening in the intestine from which the abscess had developed. In other words we had a true ascending infection along the wall of the ureter.

In former experiments with ureteral transplantation in animals the greatest source of danger seemed to be infection emanating from the opening in the intestine. There seemed to be no way to procure a sterile field for this operation.

After the publication of this paper and after the postmortem examination in my case I immediately established a dog hospital in connection with the University of Oregon Medical School and started to work out means of overcoming

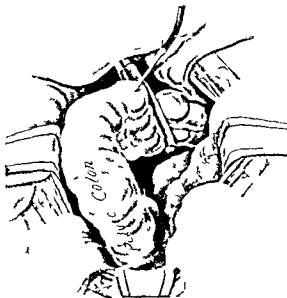


Fig. 1. Intestine clamped. Pointed cannula inserted for irrigating the bowel.

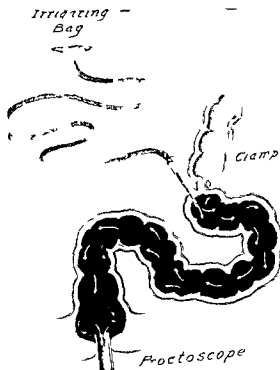


Fig. 2. Sigmoidoscope introduced, rectum being flushed of the A. C. Coll. g. f. S. g. n. Octob. 93

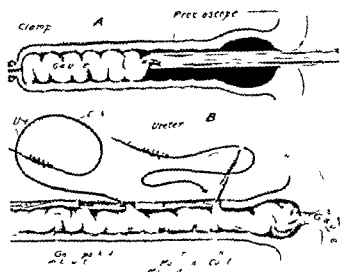


Fig 3. a The rectum is packed with dry gauze through the speculum. b Showing diagrammatically the intestine packed with gauze, ureters prepared for implantation and method of attaching end of catheter to gauze through stab wound in mucosa.

the possible difficulties to be encountered in this operation. We found that (1) infection emanating from the incision in the intestine was the most frequent cause of immediate fatality following the implantation of the ureter. (2) it was difficult to find a rubber tube stiff enough to withstand a ligature which is later to cut through the ureter and at the same time of sufficient caliber to carry the urine, (3) a ureteral catheter if large enough is ideal but as it is smooth it easily slips out of the grasp of the ligature which has been thrown around the ureter. These difficulties had to be overcome.

For this purpose the following technique was developed and proved both experimentally and clinically.

The bowel is thoroughly cleared with castor oil the day before operation. It is flushed out thoroughly from below 2 hours before operation. The abdomen is opened low down and near the mid line. All the small intestines are packed back with gauze while the sigmoid is pulled down into the field of operation. The upper end of the movable sigmoid is clamped in a rubber covered thin bladed stomach clamp. A sigmoidoscope with obturator is inserted into the lower rectum. A pointed cannula of sufficient caliber to admit the passage of a considerable stream of water is attached to the tube of an irrigator (Fig 1). The cannula is inserted through the wall of the intestine. The flow is started (Fig 2). The pelvic colon below the clamp is thoroughly irrigated until the water comes entirely clear, after which the cannula is removed and the

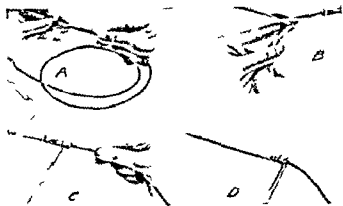


Fig 4. Ureteral catheter is prepared and fastened in the ureter. a The anchor cuff is fastened on the catheter by two ligatures. b Forceps holding ureter held in left hand, ureter being split. c End of ureter is being fastened to the anchor cuff by a double ligature. Also it is being fastened around the ureter by another ligature. d Completion of fixation of the catheter in the ureter.

puncture closed with a suture or two. After the water has all been discharged through the sigmoidoscope an assistant inserts the obturator and passes the instrument up through the sigmoid under the guidance of the hand of the operator. Then with a small long handled forceps such as is used in esophagoscopy a long strip of gauze is pushed through until the rectum is packed full of this dry gauze the sigmoidoscope being gradually withdrawn as the rectum is filled. The gauze absorbs all of the remaining fluid in the intestine and also establishes a contour which makes the operation much easier (Fig 3).

The ureters are now located and severed between small artery forceps 5 near to the bladder as possible. The distal stump is cauterized with carbolic acid and is ligated. The proximal end of the ureter is liberated for 3 or 4 inches by slitting the peritoneum over it. As large ureteral catheters as will comfortably go into the ureters are prepared. However, No. 8 answers the purpose splendidly. A piece of rubber tubing about  $\frac{3}{4}$  inch in length large enough to pass over the catheter comfortably is threaded on to the catheter to a point 4 to 6 inches above its tip. Two or three strong linen threads are now tied around this rubber cuff which is to be used as an anchor to hold the ureter. A fairly small needle armed with strong linen thread is made to take a bite of one wall of the end of the catheter. This is knotted leaving a free end 3 or 4 inches long (Fig 4a). Gauze is packed in the pelvis around the sigmoid and around the ends of the ureters. Owing to the fact that these tubes are liable to become blocked with debris, it is sometimes necessary to remove the tubes before they come away naturally. Therefore, the ureters should

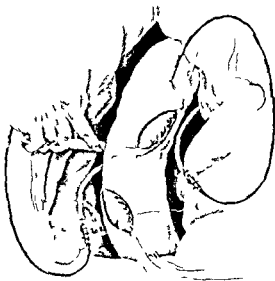


Fig. 5 The incisions being made for the implantation anchor sutures being placed at the lower angle of one wound preparatory to making the stab wound in the mucosa. The catheters and ureters are ready for implantation.

be planted as low down in the rectum as possible so they may be cut loose through a speculum or



Fig. 6 The ureter has been drawn well into the lumen the traction loops are being tied and the various sutures are being placed to cover in the ureter and bring it into its submucous position.

proctoscope if necessary. An obstructed tube rapidly destroys a kidney.

To avoid too much narrowing one incision should be higher up the bowel than the other. The incision should begin near the mesenteric edge and extend downward and obliquely toward the antemesenteric border so as to avoid as many of the large vessels as possible. The incision should be about an inch and a half in length and should go through the peritoneum and muscle permitting the mucosa to pout out partially through the incision (Fig. 5). After both incisions are made any considerable bleeding is controlled.

We next take up the ureter which is held in an artery forceps in the left hand. The index finger is held under the ureter as a rest. With a knife in the right hand an incision is made into the ureter (Fig. 4b). The catheter is now inserted into the ureter down to the cuff. A strong linen thread is passed twice around the split ureter and cuff and tied tightly with a double or surgeon's knot. A similar suture is then tied around the ureter below the incision so as to prevent infection ascending the ureter from the bowel (Fig. 4c and d). Urine usually begins to



Fig. 7 Ureteral catheters are being fastened to the gauze within the intestine through a small stab wound. Note the anchor sutures used to control the intestine during the operation.

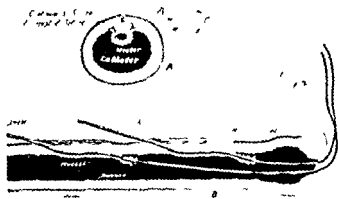


Fig. 6 Diagram illustrating the completed operation and the relation of the ureter to the mucosa

escape from the catheters at once. We next turn to the intestine. A curved needle armed with double o chromic catgut suture is made to pick up a bite of the mucosa and then pass out and pick up a bite of the muscle and peritoneum great care being used not to include the gauze within the intestine in the suture. This suture is tied and a free end about 4 inches long is left. These free ends are used as traction sutures for perfect control of the mucosa during the later steps of the operation. A small stab wound is made in the mucosa between these traction sutures. A mosquito forceps picks up a little of the gauze and to this the end of the catheter is attached by the suture already provided (Figs. 6 and 3b). After both of the catheters are thus attached to the gauze a nurse gradually withdraws the gauze from the rectum and in so doing the ureteral ends are drawn into the openings in the mucosa. The catheters must be marked in some way so as to indicate the right and left kidney. After the ureter is drawn in past the ligature the free ends of the two traction loops are tied across the ureter so as partially to close the opening. These traction loops are very important in handling



Fig. 7 Two year old child on whom lateral transplantation by this method was done 3 months before picture was taken. Child is perfectly healthy, holds the urine from 3 to 6 hours in the rectum.

the intestine. Next a needle threaded with triple o chromic catgut suture doubled is made to pick up one edge of the cut in the mucosa, pass across the cut, pick up a bite of the ureter and then the other side of the cut mucosa. This suture is tied and effectually holds the ureter in place and closes the stab wound around it. Another suture is made to take up the serous and muscular coats and also to pick up a bite of the ureter as it crosses. This holds it very effectually. It is not wise to permit more than two sutures to puncture the ureter. Other sutures are made to bring the serous and muscular coats over the ureter thus placing it in the submucous position. The needles and the long ends of the traction loops are used to bring the peritoneum across the deeper suture (Fig. 7).

## THE TREATMENT OF BLADDER TUMORS BY CHEMO-COAGULATION

By LEO S. DREXLER, M.D., BROOKLYN, AND WILLIAM GINSBERG, M.D., NEW YORK

F. m. t. h. U. l. o. g. c. C. l. c. f. P. o. f. e. s. s. o. r. E. u. g. e. n. J. o. s. e. p. h. U. n. i. v. e. r. s. i. t. y. K. J. K. B. I. n. G. r. m. n. y.

THE results during recent years concerning the treatment of bladder tumors have clearly demonstrated that whenever possible the endovesical procedure is the method of choice. Patients treated endovesically are less prone to recurrent metastatic growths inasmuch as there is not such an extensive opening of the blood and lymph vessels. In addition endovesical treatment is much easier to perform, does not require putting the patient to bed, and can be utilized in the treatment of malignant as well as benign growths of the bladder.

With the introduction of electrocoagulation by Beer in 1913 marked advances in the endovesical treatment of bladder tumors have been made. Electrocoagulation has given excellent results in the treatment of small easily accessible papilloma and also in moderately enlarged pedunculated papilloma. It can also be utilized advantageously in moderate sized bleeding papilloma provided the bleeding vessels can be reached with the electrocautery. Not all bladder tumors however can be ideally treated by electrocoagulation especially growths of large size growths which are necrotic and foul smelling and growths in which the bleeding is rather marked. It therefore behooves us in such cases to use some other method of treatment which by itself or combined with electrocoagulation is capable of eradicating the tumor growth. In such cases we recommend the use of chemocoagulation.

Since the year 1903 various attempts have been made by Frank Praetorius, Papin and others to treat bladder tumors endovesically by means of chemical agents. Not until the year 1919 with the introduction of the use of trichloroacetic acid by Professor Eugen Joseph did chemocoagulation take a definite role in the treatment of bladder tumors. Joseph definitely showed that we can penetrate tumor tissue deeper with chemocoagulation than with electrocoagulation; that small papillary tumors can be entirely eradicated; that large diffuse papillary growths can be readily reduced in size and in this way prepared for further treatment with electrocoagulation; and that in large bleeding tumors the acid arrests the hemorrhage by producing a thrombosis of the bleeding vessels.

During the past 8 years over 50 cases of bladder tumors, benign and malignant, have been treated at the clinic of Professor Joseph either by chemocoagulation alone or combined with electrocoagulation. It has been our good fortune to have been able to follow some of these cases through their entire course and we therefore present briefly the findings thereof.

**CASE 1.** A 40 year old male admitted to hospital February 7, 1927. Five years ago patient was operated upon suprapubically and a bladder tumor removed. On admission she complained of painful and bloody urination. The urine was cloudy and bloody alkaline in reaction, foul smelling and showed many leucocytes and red blood cells microscopically. Cystoscopic examination revealed bladder capacity to be 100 cubic centimeters and disclosed a solid ulcerated tumor about the size of a small apple situated at the base of the bladder and marked cystitis with fibinous exudate. Neither ureter was visible.

Chemocoagulation treatment was given on February 12, 1927, two to three bladder washings being given weekly until the next examination.

Examination on February 18, 1927, showed the urine to be cloudy, no blood, tumor markedly reduced in size, only slight necrosis present and both ureters readily visible. Case now ready for further treatment with electrocoagulation.

**CASE 2.** A 56 year old male admitted to hospital August 27, 1926. Since 1910 patient has undergone electrocoagulation at various clinics for the presence of a bladder tumor.

Cystoscopic examination revealed a large solid ulcerated tumor at the base of the bladder overlying the right ureter. The tumor mass covered with fibinous exudate. A section of a portion of tumor tissue showed the presence of an atypical benign papilloma.

Chemocoagulation treatment was given on September 6, 1926, followed by bladder irrigations twice weekly electrocoagulation, October 3, 1926, and chemocoagulation again on December 14, 1926. Examination on February 2, 1927, showed that the tumor mass had entirely disappeared and was replaced by scar tissue. The right ureter was visible, the left ureter somewhat displaced because of traction due to scar tissue.

The technique of chemocoagulation is as follows: After the introduction of a normal sized catheterizing cystoscope the bladder is washed and filled as for any cystoscopic procedure. A catheter is introduced into the cystoscope, the tip of the catheter having been cut off so that the acid will flow directly from the cut end and not from the side opening. The trichloroacetic acid must be freshly prepared. For this purpose we employ chemically pure trichloroacetic acid crystals which on heating to 55 degrees C. go into solution and



Fig. 1

Fig. 1 Beginning necrosis at end of 12 hours

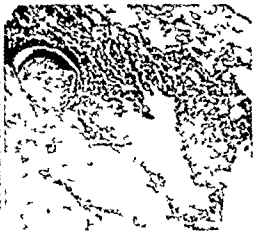


Fig. 2

Fig. 2 Necrosis extending to muscularis—4 hours



Fig. 3

Fig. 3 Forty-eight hours. Well demarcated necrosis to muscularis

recrystallize on cooling. With a spatula we place enough of the crystals into a test tube so that on heating a solution of 4 to 5 cubic centimeters is formed. To this is added 5 drops of glycerine. The test tube containing the solution is then placed in a glass of warm water so as to prevent recrystallization before using. One cubic centimeter of the solution is then drawn up into a glass syringe (metal syringe cannot be used) and while the cystoscopist directs the catheter over the upper surface of the tumor mass an assistant slowly syringes the solution through the catheter using from 20 to 30 drops. At first one notes the presence of a few air bubbles which is then followed by the appearance of the acid. The tumor mass takes on a snow white appearance due to the action of the acid. After the treatment the bladder is emptied and washed. Should the patient complain of much pain after the treatment one can introduce into the bladder 40 to 50 cubic centimeters of an anesthetic solution such as 1 per cent alpin.

Tumors situated in an area of the bladder not accessible with the cystoscope can be treated with frequent instillations into the bladder of 40 to 50 cubic centimeters distilled water containing 20 to 30 drops of trichloroacetic acid. Long standing hæmatoma from bladder tumors can also be brought to a standstill in this manner. Occasionally one encounters tumors on the anterior wall of the bladder. Such tumors can be treated endovaginally by placing the patient in the knee-chest position.

After coagulation, the patient returns two to three times each week for bladder irrigations. During this period much fibrin is thrown off and the urine is cloudy. Cystoscopic examination reveals a necrotic mass white or grayish white in

color and surrounded by a circumscribed area of bullous edema which subsides in from 10 to 20 days. During this time no further treatment should be instituted as it is often difficult to differentiate cystoscopically between edematous and true tumor tissue. At the end of 2 to 3 weeks the tumor mass has either entirely disappeared and been replaced by scar tissue or has been markedly reduced in size and ready for further treatment by chemocoagulation or electrocoagulation. In some cases after chemocoagulation there is a rapid regeneration of mucous membrane over the tumor mass which soon becomes epithelialized and renders the mass very resistant to further treatment with trichloroacetic acid. Such cases are best treated with a preliminary electrocoagulation followed by the instillation of the acid at the site of cauterization.

Objection has been raised against chemocoagulation on the ground that the trichloroacetic acid may be capable of producing a perforation of the bladder wall. Joseph has never observed any such untoward result in any of his cases in spite of the fact that frequently during the treatment a few drops of the acid will spill on the normal bladder mucosa. To prove our contention that trichloroacetic acid cannot produce a perforation of the bladder wall, and to determine the depth of action of the acid, we have carried out the following experiments on a series of dogs.

Seven dogs were employed each dog having been shaved and carefully prepared for operation. Under morphine ether anesthesia, the abdomen was opened aseptically and the bladder exposed and opened. One cubic centimeter of trichloroacetic acid was then applied to the posterior wall of the bladder through a syringe. The bladder and abdominal walls were then closed and





FIG. 4 Seventy two hours. Showing well demarcated necrosis.



FIG. 5 Complete healing with regeneration of the mucous membrane at the end of 2 weeks.

each animal allowed to live for varying lengths of time. In each case healing was by primary union. At the end of each specified period the dogs were killed and the bladders examined macroscopically and microscopically to determine the immediate intermediate and end results of the action of the acid and also the depth of the reaction. Over four hundred serial sections were made some of which are shown below.

Dog 1 was killed at the end of 6 hours. Macroscopic examination revealed an area of bullous edema at the site of application of the acid. No evidence of any necrosis. Microscopically the epithelium appeared intact with slight subepithelial hemorrhages. There was a localized edema with a leucocytic infiltration down to the muscularis.

Dog 2 was killed at the end of 12 hours. Macroscopic examination revealed an area of beginning necrosis at the site of application of the acid surrounded by bullous edema. Microscopically the above area showed a defect in the epithelium extending down to the submucosa and definitely demarcated by a leucocytic infiltration. With this there was an associated edema.

Dog 3 was killed at the end of 24 hours. Macroscopic examination revealed an area of necrosis at the site of application of the acid, the necrotic mass being firmly adherent to the underlying tissue. Completely surrounding the area of necrosis was a bullous edema extending about 2 centimeters from the margin of the necrotic zone. Microscopically the necrosis was more marked than in the previous section. It extended down to the muscularis and was surrounded by a leucocytic infiltration. The edema was less marked (Fig. 4).

Dog 4 was killed at the end of 48 hours. Macroscopic examination revealed an area of necrosis at the site of application of the acid. The necrotic tissue was firmly adherent to the underlying tissue and surrounded by an area

of bullous edema. Microscopically there was a well demarcated necrosis extending down to the muscularis. Edema very slight. Some round cell infiltration in the subserosa (Fig. 3).

Dog 5 was killed at the end of 72 hours. Macroscopic examination revealed an area of necrosis surrounded by bullous edema. The necrotic area was well demarcated and could readily be removed from the underlying tissue. Microscopically the demarcation was more pronounced with a round cell infiltration separating the area of necrosis from the muscularis (Fig. 4).

Dog 6 was killed at the end of 2 weeks. Macroscopic examination showed no evidence of any reaction at the site of application of the acid. The mucous membrane was intact. Examination of the kidneys revealed no evidence of any ascending infection. Microscopically there was a connective tissue replacement of the submucosa with a regeneration of the mucous membrane (Fig. 5).

Dog 7 was killed at the end of 4 weeks. Macroscopic and microscopic examination revealed complete healing at the site of application of the acid. The kidneys showed no evidence of any ascending infection.

In none of these experiments was there any evidence of perforation or permanent injury of the bladder mucosa.

#### CONCLUSIONS

From the foregoing experiments we can conclude that trichloroacetic acid can safely be used in the treatment of bladder tumors. It cannot produce a perforation of the bladder wall, the depth of reaction being limited to the muscularis.

Clinically we can conclude that in the treatment of bladder tumors, both benign and malignant, the endovascular approach is the method of choice. Possible exceptions to this are favorably located infiltrating carcinomata in patients of

good general condition, in which cases resection is more advisable.

Small benign papillomata are best treated by electrocoagulation whereas larger atypical papillomata especially those showing evidence of active bleeding are best treated by chemocoagulation with trichloroacetic acid or by a preliminary chemocoagulation followed by electrocoagulation, depending on the size of the tumor mass.

Chemocoagulation should be employed in the treatment of all bladder tumors showing evidence of beginning malignant changes.

Chemocoagulation is especially indicated in those cases of bladder carcinomata presenting marked foul smelling necrosis and bleeding with secondary cystitis. In this way the necrosis and bleeding can be cleared up and the tumor mass reduced in size sufficiently to allow further treatment with electrocoagulation.

Chemocoagulation cannot prevent metastasis and recurrence of bladder tumors but can prolong the life of the patient by clearing up the local condition. In the clinic of Professor Joseph

we have observed several cases of inoperable papillary carcinoma of the bladder which have undergone treatment with chemocoagulation and are still doing well at the end of 4 to 5 years.

Chemocoagulation has no permanent injurious effect on the normal bladder mucosa even if accidentally spilled during the treatment. Its reaction consists of a bullous edema with or without a superficial necrosis. The edema readily subsides whereas the necrotic area is restored to normal or goes on to scar tissue formation which in no way causes any physiological disturbance.

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## A NEW METHOD OF COVERING DENUDED AREAS WITH THE SURROUNDING SKIN

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**M**y purpose in this report is to describe a method of covering raw surface with the surrounding skin instead of with a pedicled flap or with skin grafts. In the repair of wounds of the face or injuries of any part of the body in which infection has been present and there has been a great loss of skin and underlying soft structures it is customary to allow the infection to clear up and the wound to granulate. Several months are then allowed to elapse to make sure that no infectious organisms are present before any effort is made to finish the operation. If the area involved is a bearded surface, it is hardly possible to graft skin to correspond with the surrounding area. A moment's consideration will show that a better method is to apply traction on either side of the wound sufficiently strong to overcome the normal tension of the skin. In this way the margins of the skin on each side are brought in apposition. By the time the affected space has filled in, it is usually covered with nor-

mal skin which corresponds with the surrounding area.

We have all seen skin proliferate when called on to do so from an underlying pressure such as that from large cystic goiters or lipomas.

To get the best results in wounds in which there has been extensive skin destruction continuous traction should be applied on either side of the wound immediately, before the margins of the skin are bound down by scar tissue. In this way the area is soon covered. The rapidity of repair depends on the amount of traction applied. If the skin is carried across the surface faster than the granulations fill in, there will be a depression, which may later be filled in by a graft. This method is a great time saver for the patient, as the raw surface is soon covered and he can select the time best suited for the final operation.

The young man shown in Figure 1 was accidentally shot at close range with a shot gun, January 18, 1926. A large area of the skin and



Fig. 1 Appearance of patient January 27, 1926, 9 days after injury



Fig. 2 About 15 days after treatment by traction method



Fig. 3 Showing appearance on March 4, 1926



Fig. 4 Method of applying traction by rubber bands in attached hooks on each side of wound to produce desired tension



Fig. 5 Showing extent of improvement by July, 1926, 6 months after injury

soft structures and a portion of the molar bone were torn away and the antrum was opened. He was first treated by the traction method February 1, 10 days after his injury.

#### TECHNIQUE

The loose epithelial cells and oil from the skin on each side of the wound are removed by rubbing with a sponge saturated with ether. The ordinary dress hook fasteners are sewed on pledgets of gauze one half inch wide by 1 inch long.

These strips are thoroughly saturated on the under side with Carpentier's court plaster and are placed near the skin margin on each side of the wound in such a manner that small rubber bands can be fastened in the hooks in order to produce continuous traction and gradually draw the skin margin together. To avoid irritation of the skin these pledgets of gauze should not remain in the same position longer than 48 hours. When they are removed they should be reapplied in a different location.

## RECONSTRUCTION OF THUMB AFTER TOTAL LOSS

BY GIORGI WAKKEN PIERCE M.D. SAN FRANCISCO

THE thumb is the key stone of manual dexterity. Try to pick up a pin, a coin or even a pencil without using the thumb, and its value becomes strikingly evident. Consider then the devastating effect of the loss of this factor of the hand upon a skilled artisan whose livelihood depends on his manual skill. In this day of machinery there are a multitude who have suffered this injury.

When I was confronted with such a patient the possibility of reconstruction of the member suggested itself. The resultant of the several stages was a successful summation of the original plan and the value of the cosmetic result which was fair enough, was far outstripped by the restoration of function, the power of opposition of thumb to fingers. The patient was enabled to resume at once his former occupation of assembling locks which requires considerable manual dexterity.

The author desires to report the history and method pursued in this case.

On September 4, 1924, F. R., age 25, lost the thumb of the right hand by crushing it in a press. There was complete severance through the thenar eminence just distal to the carpometacarpal joint. Within 3 hours the patient was hospitalized and a complete débridement of the wound was done under gas anesthesia. The torn adductors of the thumb were sutured around and over the stump of the first metacarpal but aside from this the wound was not closed. Normal saline compresses were applied and cultures taken daily. No growth was revealed and on the fourth day the raw area was covered with Thiersch graft in a single piece. The graft was splinted with rubber sponge, the author adopting this method as he realized the necessity for a constant even pressure which is difficult to control in this region. The use of rubber sponge as a splint for grafts will be reported elsewhere. The entire graft was successful.

Figure 1 shows the hand after the skin graft had been made.

Two weeks after the injury a tubed pedicle of the Gillies type was made on the right side of the abdomen. Four weeks later, or six weeks after the injury, the lower end of the tubed pedicle was severed from the abdomen, the skin graft was dissected from the thenar eminence and the end of the pedicle was sutured to the defect. The arm was maintained by a sling and swathe. Healing was uneventful and 3 weeks after operation or 9 weeks after injury, the pedicle was severed from the abdomen and the free end closed.

A considerable period was then allowed to elapse to permit shrinkage of the grafted pedicle. This shrinkage proved to be very moderate.

Figure 2 shows the pedicle at that time.

On April 22, 1925, 7 months after injury and 5 months after completion of grafting the pedicle to the hand, a bone graft 8 centimeters long was taken from the crest of the right tibia. The line of cleavage was outlined with a drill and the removal completed with a chisel. This graft was triangular in cross section and carried periosteum on two surfaces. The base of the tubed pedicle was opened on the radial side by a T incision, the cross incision following the line of junction of the pedicle with the hand and the vertical incision extending proximally along the radial border of the thenar eminence. The stump of the metacarpal was uncovered and the medullary cavity drilled out the drill hole extending well into the base of the metacarpal. The end of the graft was then shaped with a rongeur to fit the hole. Next, the body of the tubed pedicle was tunneled with a Mayo hemostat. This permitted the bone graft to be easily slipped into the pedicle and then



Fig. 1



Fig. 2



Fig. 3

Fig. 1 The hand after skin graft was done

Fig. 2 Photograph of hand after shrinkage of pedicle

Fig. 3 Photograph of the hand showing the amount of abduction



Fig 4 Appo ing thumb



Fig 5 Holding pin



Fig 6 Holding pencil



Fig 7 Holding hammer

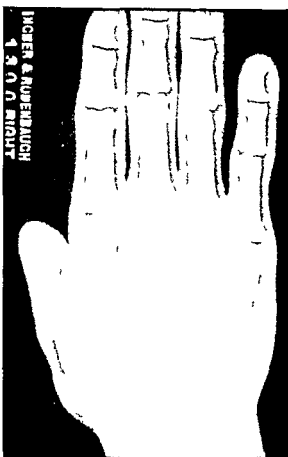


Fig 8 Roentgenogram of hand showing condition of bone graft 9 months after application

firmly forced into the prepared metacarpal base. The entire hand was immobilized in plaster of Paris splint where it remained for 6 weeks. When the splint was removed bony union of the graft to the metacarpal was excellent.

Passive motion was not resorted to in the after care but the patient gradually increased function by voluntary effort. As will be remembered the adductors of the thumb were sutured around the

stump of the first metacarpal. Abduction is provided by the extensor ossis metacarpi pollicis and is shown in Figure 3. The patient can readily appose the thumb to the index, middle and ring fingers as shown in Figure 4.

Figures 5 and 6 illustrate the dexterity of the hand: the first, the picking up of a pin and the second, the use of a pencil.

The strength of both the bone graft and the acting thenar muscles are indicated by the use of the hammer (Figure 7). These photographs of function were taken more than one year after the completion of the reconstruction.

Figure 8 is an X-ray picture of the hand taken on January 20, 1926, 9 months after the bone graft was placed. It will be noted that the permeability by X-rays of the graft is almost the same as the permeability of the other bones of the hand. Measurements taken on X-rays at various dates indicate that there has been no demonstrable absorption of the graft.

The fate of bone grafts of this type has occasioned considerable debate but in this case there has been no apparent change. It is of interest to consider that the blood supply to this graft must come from the tubed pedicle which itself has a secondary blood supply obtained through a ring of scar tissue at its base.

Also of interest is the fact that 18 months after completion of the reconstruction sensation to pin prick was equally acute in all parts of the graft and was also equal in acuity to sensation to pin prick in other parts of the hand. Heat and cold were clearly distinguished but not quite so readily as in the normal.

Asterognostic sense was very limited probably because of the lack of joint sense.

It will be noted that this thumb is shorter than a normal thumb but it was so planned as a thumb of normal length without metacarpophalangeal and interphalangeal joints would not function readily, it would be in the way. This reconstructed member is practically equivalent to a normal thumb amputated at the interphalangeal joint.

## X-RAY PELVIMETRY—A SIMPLIFIED TECHNIQUE

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FOR the past 6 years, I have been interested in using the X-ray as a means of determining the diameters of the superior strait of the pelvis in the living subject. The principles of the method have for the most part been set forth in a previous communication.<sup>1</sup> At the present time, however, the technique has been considerably simplified and it is the purpose of this paper to describe the procedure which is now employed.

As has been pointed out before, one of the chief essentials is that the patient shall be placed in such a position that the superior strait becomes parallel to the sensitive plate. This is possible when the patient is in a semi-recumbent position with the back more or less arched (Fig. 1, C).

In order to determine the level of this plane we identify two points on the external surface of the body, one on the anterior and upper border of the symphysis pubis and the other posteriorly at the depression just below the spine of the fourth lumbar vertebra. An imaginary line between these two points traverses the anteroposterior diameter of the superior strait. For purposes of identification, we usually place a small strip of adhesive over the posterior landmark. This is shown in Figure 2. By means of calipers we are able to render these two points equidistant from the plane upon which the patient sits, and this is shown graphically in Figure 2. This distance is also measured for purposes to be explained later.

With the patient in position, the tube or target is placed at a distance of 36 inches above the sensitive plate, over a point 5 centimeters posterior to the upper and posterior border of the symphysis

The tube is centered by means of a plumb line. In our experience, a moderate variation does not materially affect the end result. Thus, the target or tube may vary 1 or 4 centimeters away from the point above the center of the superior strait or the superior strait itself may tilt 1 or 1.5 centimeters away from the absolute horizontal and the end reading will not be affected more than a millimeter or so. This amount of leeway makes the method one of practical interest, because of personal variations which may occur.

In the previous communication a series of calibrated lead strips were used with each plate to denote the amount of divergence away from the vertical that the rays underwent in their passage from the tube through the patient to the plate. Without further comment on these accessories we may say that they have been eliminated and in their place a lead sheet substituted (Fig. 1, B). This is a sheet of lead about 1 centimeter in thickness mounted on a board and perforated in the center with very small holes exactly 1 centimeter apart. Every fifth hole is double, as shown for purposes of easy reading. The use of this sheet which is placed in the same plane as the superior strait, is described as follows.

The patient is placed in the position shown in the exposure is made, which varies according to the weight, etc. of the patient and with the tube and sensitive plate still in position, the patient is removed from the apparatus. The distance of the height of the superior strait above the plane upon which the patient sits having previously been determined with calipers, the lead sheet is placed in the same plane (Fig. 1, A), and another (flash) exposure made on the same plate.

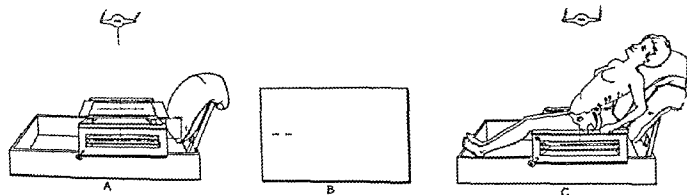


Fig. 1. Diagram of apparatus and of position of patient

<sup>1</sup>Thomas H. The clinical significance of X-ray pelvimetry. *Am. J. Obst. & Gynec.* 1926 211 1926

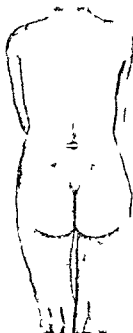


Fig. 3 Adhesive identification tab placed in interspace between fourth and fifth lumbar vertebrae

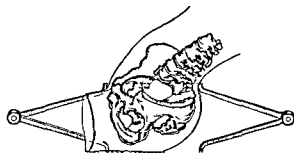


Fig. 4 Drawing showing leveling of superior strait by means of calipers

On developing the plate an outline of the superior strait is readily seen slightly and equally enlarged with a series of dots through the plane representing corrected centimeters. Any diameter of the superior strait may be measured by this scale and a pair of calipers and the antero-posterior diameter may be read directly (Fig. 4).

The exposure and other X-ray technique is here repeated. Duplitzed superspeed films a double screen with Bucky diaphragm and a medium focus Coolidge tube are used. The distance of the target plate is 36 inches. A point spark gap distance of 7 inches—which is equivalent to approximately 65 kilovolts—is employed. The amount of current is 20 milliamperes and by using an ammeter in filament circuit this voltage can readily



Fig. 4 Pelvigram showing outline of superior strait. Scale in corrected centimeters shown in center (see text)

be obtained without passing the current through the tube. A medium focus Coolidge tube will run easily up to approximately 20 seconds at this setting without greatly overheating. There is no apparent reason why with a heavy patient the tube may not be allowed to cool for 10 or 15 seconds the patient holding the arched position with possibly a second setting of the Bucky diaphragm. The time of exposure is as follows:

#### Pregnant

	Sec. or ds.
Thin	16
Medium	20
Heavy	30

#### Non pregnant

	Sec. or ds.
Thin	10
Medium	14
Heavy	17

Compared with other methods of X-ray pelvimetry I feel that this procedure is one of unusual simplicity. After the preparation of the lead sheet and the frame upon which the Bucky diaphragm rests no further mathematical exercise is necessary.

A word as to the use of this method of pelvimetry in practical obstetrics. With us the method is by no means routine and is reserved for those cases in which definite information is desired as to the diameters of the superior strait in a given pelvis. This includes those cases in which external measurements show the likelihood of inlet contraction and in those cases at term in which disproportion occurs or in which the fetal head is floating and cannot be brought into favorable approximation with the superior strait. The usefulness of this method in the classification of pelvis and in constitutional studies is apparent.

TUMOR OF THE CAROTID BODY<sup>1</sup>

B A E F TRAUT M D CHICAGO

THE carotid body was first described by the school of Haller in 1743. Interest in this structure was revived by Luschka's description in 1862. The carotid body is an ovoid structure about 5 millimeters long, millimeters broad and 1.5 millimeters thick. It is suspended by a mesh of nerves and blood vessels in the bifurcation of the common carotid artery or may be bound to the medial side of that vessel.

No one has improved upon Luschka's histological description. The carotid body consists of alveoli separated by interlacing filaments of nerves, blood vessels and connective tissue. Within the alveoli large pale cells are strewn. These cells seem to have no limiting membrane. Their nuclei are large, pale and vesicular. These cells are regarded as the specific elements in the structure. They contain varying amounts of chromaffin. The walls of the alveoli are richly supplied with medullated and non-medullated nerve fibers and large numbers of ganglion cells. The carotid body is very vascular. It has been called carotid ganglion, glomerulus arteriosus, intercaroticus and glandula carotica according as the writer has focused his attention on the nervous elements, the vascularity, or the glandular structure.

Not even the embryologists are in accord on the origin of the carotid body. Smith as well as Arnold (quoted by Klose) regards a convolute of vessels coming from the external carotid as the essential "anlage." The large pale cells in the alveoli then arise from the loose connective tissue forming the investment of the vessels. According to Kohn, the carotid body arises as a collection of large pale cells originating in the near by superior sympathetic ganglion. These characteristic cells soon acquire the property of reducing potassium dichromate, a peculiarity of the cells in the chromaffin system. Indeed the origin and histology of the carotid body is similar in most respects to that of the adrenal medulla. A branch of the external carotid grows out to supply this primitive carotid body with a rich plexus of capillaries.

An endocrine significance has been repeatedly ascribed to the carotid body. Conclusive evidence on this point is lacking. Schmidt noted no effect on removing both carotid bodies from rats. Extirpation of one carotid body did not lead to hypertrophy of the other. Fischer extirpated both carotid bodies from young rats. The bones of these animals developed a condition resembling osteomalacia and the parathyroids hypertrophied. Schmidt reports a case in which tumor formation



Fig 1 Section of Dr Davis's tumor. Shows alveolar structure and syncytial arrangement of the large pale cells. An occasional giant cell is seen 100X.



Fig 2 Section of Dr Stewart's tumor. Large, pale cells are seen more plainly. The fibrous septa contain capillaries. Several giant cells are visible. 115X.

<sup>1</sup>Read before the Chicago Neurological Society February 10, 1927.



led to removal of both carotid bodies from a woman 52 years old. There were no ill effects. Kluge deflected both carotid glands from the circulation with no other effect than that of trauma. He concluded that the carotid bodies are not necessary to life. According to him the adrenals and thyroids can compensate for the loss of the carotid bodies. Gomez and Frugoni independently injected glycerin extracts of the gland. Gomez saw the blood pressure sink. In Frugoni's animals the blood pressure rose.

Marchand and Paltauf simultaneously and independently first described tumors of the carotid body. Up to the present about one hundred such tumors have been reported. The lack of agreement in naming the carotid body has been reflected in the naming of carotid body tumors. Because the histology of the tumors is so similar to that of the carotid body itself, Klose prefers *Beitake* and v. Gierke's non prejudicing name of *carotid body struma*. In most cases the tumors have been simple hyperplasias of the normal structure or adenomata. Albrecht calls tumors of this sort hamartomata or developmental deformities. He separates them from the true tumors. Marchand, Paltauf, Moenckeberg and Kaufmann call the tumors *peritheliomata*. According to them the specific large cells crowding the alveolar spaces arise from the connective tissue about the blood vessels. Chian and Alezys and Peyron said that these cells arise from the endothelium of the vessels. Most of the tumors resemble the normal carotid body histologically. The system of septa and filaments is exactly reproduced. In the alveolar spaces lie the large cells, some taking the chromaffin stain. In a minority of these tumors there are malignant changes. Then the cells are seen infiltrating the capsule and even invading the vessels. Metastases and these only regional have been reported in two instances. Gilford and Davis reported three cases of submastoid potato tumors. These lacked the characteristic vascularity of the true carotid body tumors. They are outspokenly malignant and of doubtful origin. Kaufmann and Moenckeberg exclude these potato tumors from the tumors of carotid body.

We have two cases to add to those previously reported.

**CASE 1.** Our first patient was a married woman 46 years of age. She presented a painless swelling about the size of a hen's egg just anterior to the upper end of the sternomastoid muscle. This swelling was noted 12 years ago following a severe shaking up in an automobile accident. The only symptom attributable to the swelling was an occasional attack of inspiratory spasm. In the last 3 years this has awakened her several times compelling her to sit

up in bed to breathe. She wished the swelling removed for cosmetic reasons. The swelling was firm fixed and pulsated. The patient was otherwise in splendid health. She was not hoarse. The pupils were equal and normal in size. Her pulse rate was 84. The respiratory movements had a normal excursion 16 to the minute. Dr. H. J. Stewart performed the operation at the West Suburban Hospital. The diagnosis was tuberculous adenitis. The tumor surrounded the carotid bifurcation. The vagus nerve was adherent to it. The tumor the carotid fork and about 2 inches of the vagus nerve were resected. Neither the surgeon nor the anæsthetist noted any immediate change in the patient's condition. One hour after the operation the patient spoke in a low voice. Within 24 hours she had a complete right hemiplegia and aphasia. I first saw her at this juncture. There was a flaccid paralysis of the entire right side of the body including the face. The blood pressure and urine remained normal. The eye movements were normal. Both discs were equally red. She was fed twice daily by stomach tube. On the sixth postoperative day she developed a lronchopneumonia. She died 22 days after the operation.

Immediately after the operation her pulse was 104 and soon rose to 140. It remained between 140 and 160 until her death in spite of the daily injection of 6 grains of digitalis in the form of digitalin. The digitalis was given not only to sustain the heart but also as a pharmacological experiment. With the resection of the vagus the effect of the dipsos or nerves was to some extent also removed. If digitalis has a local effect upon the myocardium or the vagus endings the pulse rate should have fallen. On the contrary, it remained unaffected giving further support to the belief that the digitalis effect is due to stimulation of the vagus center and requires an intact vagus nerve.

Autopsy disclosed a purulent bronchitis and bilateral bronchopneumonia. There was a minimum of arteriosclerotic changes in any of the vessels. The vessels at the base of the brain were all present and normally arranged. The left cerebral hemisphere was larger, softer and more cyanotic than the right. There were extensive areas of encephalomalacia especially in and about the internal capsule.

Histologically the tumor consists of a connective tissue core, framework and capsule inclosing the alveolar spaces. In these spaces are scattered large nuclei in homogeneous cytoplasm. Parallel connective tissue fibers form the nuclei form the capsule. The capsule is well supplied with wide thin walled vessels. Interlacing fibers from the capsule mark off more or less round cell nests. They then course in a more or less central direction to unite into a heavy fibrous trunk. Whole groups of cell nests are again surrounded by somewhat heavier fibrous partitions. That part of the tumor immediately under the capsule is rich in cells. The cytoplasm in the cells is homogeneous and without walls. In some places cell boundaries seem to be visible. This may be an artefact of the fixing process. The nuclei are usually oval and are well demarcated. Each nucleus contains one to three nucleoli. Giant cells of the type termed tumor giant cells with large very dark nuclei are prominent in many parts of the tumor. More uncommon is the Langhans variety with nuclei placed radially and peripherally.

Throughout the tumor there is a diffuse round and plasma cell infiltration of the connective tissue septa. Here and there the infiltration is more or less focal. In the center of such foci the tumor tissue is faded and structure is blurred. Many polymorphonuclear forms are seen in such areas. Small hæmorrhages are common. These are evidently spots of necrosis.

The vessels of the tumor are principally within the endothelial tubes. In a few cases the endothelium is surrounded by

parallel layers of fibrous tissue. Arterioles with muscular walls are entirely lacking in our sections.

In no place have the tumor cells infiltrated the capsule or perforated a vessel.

CASE 2. In 1906 Dr. Carl Davis removed a tumor of the carotid gland from a laborer 5 years old at the Presbyterian Hospital of Chicago. The man had been aware of the tumor for 3 years. It had been steadily enlarging. It was painful. The patient was hoarse. The operative examination showed a mass normal in every way except for a tender swelling the size of a hen's egg just below the right ear. There were no abnormalities in the blood count or blood pressure. The large artery was normal. The urine contained a trace of albumin and a few hyaline casts but no sugar. The tumor was removed from the carotid fork with out ligating the vessels nor injuring the vagus. It was necessary to resect the descending branch of the hypoglossal. The patient talked shortly after the operation but was unable to swallow. The day after the operation he was in a stupor. Dr. Bassoe dictated the diagnosis of left hemiplegia and hemianesthesia due to right cerebral aneurysm. The patient died in 3 days of bilateral bronchopneumonia. The histological picture of this tumor is practically the same as that of the previously reported case.

Tumor of the carotid body is usually noticed in the third or fourth decade. It has been seen at 7 years and in a patient of 68. It is usually unilateral. Only two instances of bilateral carotid tumor have been recorded. It occurs as commonly on the right as on the left side and in men as often as in women. When seen by the surgeon it has usually been slowly enlarging for several years. The reason for operation is usually cosmetic. It has rarely been diagnosed correctly before removal. Its growth is usually slow. Metastases are rare and then only to the regional lymph glands. The lack of symptoms from these tumors is remarkable in view of their proximity to important vessels and nerves. In several of the cases, there have been such pressure effects as pain ringing in the ear and dysphagia.

Objectively they cause bulging of the neck in the region of the carotid fork. The skin over the tumor is freely movable. The tumor itself can be moved from side to side but not vertically. The surface is usually smooth. Continuous pressure gradually decreases the size of the tumor by squeezing out the blood. The tumor usually pulsates. There is usually a thrill and a bruit. Large carotid tumors bulge into the pharynx. By involving the superior laryngeal nerve it may cause vocal cord paralysis or spasm.

When first seen they are usually considered carotid aneurysms, enlarged lymph glands, or branchial cysts.

The only treatment is surgical. It has been necessary to resect the internal carotid or all other carotids in 70 per cent of the reported cases. Seventeen per cent of these cases developed hemiplegia. The vagus has been resected in 20 per

cent of the operations. One half of these patients have died. Birman gives 29 per cent as the operative mortality. Fifty three per cent of the patients are more or less disabled after the operation. Only 15 per cent have had an uncomplicated recovery. The best prognosis is given to those patients in whom the tumor has gradually produced more or less occlusion of the carotids. In the opinion of Keen only severe symptoms or rapid growth with suspicion of malignancy can justify an operation fraught with such danger. Preliminary ligation of the jugular has been suggested to prevent the sudden cerebral anemia consequent upon the ligation of the internal carotid.

#### SUMMARY

Two new cases of carotid gland tumor are reported.

The histological picture is the same in both. Both have an alveolar structure.

In one patient the carotid arteries and the vagus nerve were sacrificed.

Both patients developed hemiplegia.

Both patients died of pneumonia.

#### CONCLUSION

Tumor of the carotid gland must be considered when dealing with tumors of the neck.

Indications for operation upon a tumor of the carotid gland must be very imperative.

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To induce a maximum degree of quiet and of freedom from restlessness and nervousness 30 grains of sodium bromide are given every night and if the patient is markedly nervous and apprehensive, one and one half grains of luminal are given twice a day. Morphine is not indicated in the uncomplicated cases.

Although patients vary greatly in their response to this plan of management in the average case optimum improvement is secured in from 7 to 10 days and the patient is then considered ready for operation. However, there is no definite criterion whereby to determine the optimum physical condition in any individual patient and therefore the determination of the optimum moment for operation must depend on clinical judgment based upon increasing clinical experience with these patients. It is certain that in each case the utmost possible degree of mental and physical repose should be gained and only by constant study of each individual case can it be determined when that moment has been reached.

A patient who appears to be extremely apprehensive and excited, talks rapidly and almost incessantly, with some part of the body always in motion and is emotionally unstable is not a good operative risk even though the heart has responded well to treatment and the pulse rate is reduced.

For patients in the second and third groups which include cases of hyperthyroidism with cardiac decompensation and evidence of extreme toxicity, special care and watchfulness must be exercised both before and after the operation and the pre-operative preparation usually requires a longer period of time than in the first group. Atrial fibrillation and other arrhythmias are not uncommon in patients with hyperthyroidism and normal cardiac action can not always be restored by the use of digitalis. Unless the decompensation in these patients is extreme they usually stand the operation well. If the effect of cardiac decompensation has progressed to the stage of anasarca, marked improvement may be brought about in many cases by the intravenous administration of novasurol. This pre-operative treatment will even make it possible in some cases

to perform lobectomy as the primary operation when formerly one or two preliminary ligations would have been required.

Of particular menace in cases of hyperthyroidism is the presence of delirium, diarrhoea, and vomiting. In such cases morphine is indicated and should be given in doses of from  $\frac{1}{8}$  to  $\frac{1}{4}$  of a grain repeated sufficiently often to secure complete relaxation. In some cases it may be necessary to add  $\frac{1}{16}$  to  $\frac{1}{8}$  of a grain of scopolamine. These patients are usually dehydrated and the trick of water should be supplied by the subcutaneous administration of saline solution 1000 cubic centimeters being administered by hypodermoclysis twice a day. In the case of some delirious patients the transfusion of from 500 to 500 cubic centimeters of whole blood is followed by definite improvement. If the patient can take anything by mouth fluids are forced, and treatment with Lugol's solution and digitalis is started. If medication by mouth is impossible, iodine is introduced by adding from 4 to 6 cubic centimeters of Lugol's solution to the saline solution for hypodermoclysis and also by the application of some preparation of iodine to the skin of the abdomen and the cardiac condition is combated by the subcutaneous administration of digifolin, 1 cubic centimeter every hour for from 5 to 8 doses.

The administration of 500 cubic centimeters of a 10 per cent solution of glucose also is frequently useful in these cases.

By the application of these measures, even the most severe case if not actually moribund may be brought to a condition in which the operation may be safely performed and as stated above, in many cases in which a preliminary ligation would formerly have been considered the essential primary measure, lobectomy is now performed without any severe postoperative reaction.

The keynote to the successful management of the patient with hyperthyroidism is therefore, knowledge of the effective measures by which to combat each emergency which may arise together with such a study of each individual case as may make it possible to apply each of these measures in advance of the emergency.

## PROBLEMS IN PLACENTA PRÆVIA

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**T**HIS paper is based on a study of 57 consecutive cases of placenta prævia delivered by me or by assistants under my immediate direction. Of this number 2 mothers died, a mortality of 3.5 per cent. There were no deaths from hæmorrhage in the series but both patients succumbed to sepsis.

The gross fetal mortality was 57.9 per cent. The death rate among the babies who might have survived that is those who were neither non-viable monsters or dead on admission was 45 per cent. It is evident therefore that with a low maternal mortality an unduly large number of infants were lost. Since the methods used to deliver these patients largely metrecruris and Braxton Hicks version were aimed solely toward losing as few mothers as possible the result demonstrates that this may be accomplished. The same methods unfortunately which are safest for the mother are the most dangerous to the baby. By a study of these cases and from consideration of the work of others I am led to conclude that in the future the more liberal use of Cæsarean section in carefully selected cases will save more infants without detracting from the mother's chances of recovery.

I shall deal first with the diagnosis of placenta prævia summarize the cases comprising this series consider in some detail the questions of maternal and fetal mortality and conclude with an outline of what would appear to be the rational treatment in each of the varied circumstances accompanying this condition.

## DIAGNOSIS

All patients who have bled at all in the second half of pregnancy should have a thorough vaginal examination under an anæsthetic. Since in its initial stages the bleeding from placenta prævia is often very slight it is imperative to investigate all losses of blood of whatever degree. The vast majority of visible hæmorrhages from the fifth lunar month on are due either to placenta prævia or to premature separation of the normally implanted placenta both conditions of the utmost gravity. Since the treatment of the two conditions is not always the same it is essential that the obstetrician should distinguish between them.

At the Boston Lying-in Hospital all patients

who have bled are at once admitted. They should never be examined in their homes or even in a pregnancy clinic but only under circumstances suitable for the aseptic induction and conduct of labor should it be found necessary. Moreover a brisk hæmorrhage is sometimes set up by the manipulations of making the diagnosis. Since this may be the case the obstetrician should never find himself in the embarrassing position of being unable immediately to cope with such a situation. Accordingly on admission to the hospital the patients and their husbands sign an operative permit authorizing us to terminate pregnancy or to perform any surgical operation that we may consider necessary. Voorhees bags and instruments for their insertion are sterilized and at hand. The patient is taken to a delivery room anæsthetized with nitrous oxide and oxygen and examined under the strictest aseptic precautions. The whole hand is introduced into the vagina and a finger is for its entire length inserted through the cervix. The finger is swept around the whole circumference of the lower uterine segment. If the placenta is felt the diagnosis is evident. Should the placenta not be felt and if ablatio placente, hydatidiform mole and an intra uterine tumor can be ruled out then the cause of the bleeding must be sought elsewhere. A speculum is introduced and the cervix viewed. In many cases bleeding erosions will be disclosed less often a cervical polyp may be present.

The most common error in the diagnosis of placenta prævia is lack of thoroughness in examination. On several occasions the condition has been overlooked by members of the hospital staff because they did not anesthetize the patient insert the hand into the vagina insinuate the finger through the cervix and explore the whole region of the uterus within its reach. I have never known the diagnosis to be missed when this routine has been carried out.

Since it is our belief that there is no expectant treatment for placenta prævia once the diagnosis is made the obstetrician's task is about the termination of pregnancy by the most appropriate means regardless of the viability of the child. In the past some have advocated that when the fetus had not quite reached the period of viability the patient should be put to bed until

the infant had developed sufficiently to stand a fair chance of survival. We believe that such an experiment is a dangerous one. Too often a furious hemorrhage has ensued even when the patient was in a well equipped maternity hospital with the result that the baby was not saved and the mother's life needlessly endangered. In placenta prævia it is better to take no unnecessary chances with the mother's life and at this stage of pregnancy to disregard the baby. It is better to wipe the obstetrical slate clean. If the patient lives she may have another child.

It is obvious that the technique of diagnosis as just outlined is a matter for the obstetrical specialist and should be carried out in a proper hospital. The general practitioner faced with a case of bleeding in the second half of pregnancy will best serve the interests of his patient if he makes no vaginal examination whatever and sends her to the nearest hospital if there is one available. Until all preparations are made for treatment, the diagnosis is of relative unimportance, and it is the bleeding that is the outstanding feature. Especially will the local physician do his utmost to insure the patient's recovery if he refrains from packing the vagina. This pernicious act as performed outside the hospital practically never stops the bleeding and as it is usually done hastily by a poor light and without due regard for sepsis it only invites infection. Ballhorn (1) states that 20 per cent of the cases that have been tamponed at home develop puerperal sepsis.

#### TYPES

Of the 57 cases, 12 were complete, 16 were partial and 29 were of the marginal variety. One of the two patients who died had a complete placenta prævia and the other a marginal.

As might be expected, the type of placenta prævia had a considerable effect upon the infant mortality. The percentages of stillbirths and neonatal deaths among viable babies were:

Complete	11.11
Partial	55.6
Marginal	61.5
	34.8

#### METHODS OF DELIVERY

Since in the treatment of these cases the primary object was the immediate arrest of the hemorrhage, the first step was to exert pressure against the placental site either by metreurysis or by Braxton Hicks version. The general policy has been to perform Braxton Hicks version on all cases admitted in *de potestate* condition, as well

as on those with non viable or dead infants if it were possible to do so. If the cervix were not dilated sufficiently to admit two fingers for the bringing down of a foot, a Voorhees bag was introduced. Upon the passage of the bag an immediate internal podalic version and extraction was done provided that the os was fully dilated at that time. If full dilatation had not occurred and any cervical edge of any extent whatever remained the infant was turned a leg brought down and the expulsion left strictly to nature.

Cases in good condition with alive and viable fetuses were for the most part treated by metreurysis with the hope that the infant would stand a better chance of survival than by Braxton Hicks version. In about half the cases the bag was placed outside the ovum in the others it was used intra-ovularly after perforation of the membranes or placenta. The intra-ovular use of the bag has given better results as regards the loss of blood immediately following its expulsion. Perforation of the ovum appears to allow the placenta a better opportunity to retract from the os as dilatation progresses.

Patients with viable fetuses entering the hospital in active labor and bleeding in whom considerable dilatation had already taken place were treated at once by Braxton Hicks version, since in these patients the cervix is so soft and well dilated that the bag is returned only temporarily.

In no instance was the cervix dilated either manually or by traction on the leg after the baby had been turned. When the bag was used, only enough weight was applied to the stem to check the bleeding. It is to this factor alone that I attribute the absence of any deaths from hemorrhage. Deaths resulting from hemorrhage not only on other services in this hospital but also in other clinics I believe to be due to neglect of this precaution. The cervix in placenta prævia is exceedingly soft and friable, it tears with the proverbial ease of wet blotting paper, it should always be treated with the greatest respect. It is a great temptation to the inexperienced and would be spectacular operator to deliver the baby through it *à la matris*, but if he gives way to this temptation the demise of the patient may be expected promptly. This fact has been known for a very long time yet in spite of constant reiteration it is still often forgotten (Table I).

The two cases delivered by the abdominal route deserve special mention.

CASE 1. Mrs. I. was 39 years old. This was her first pregnancy after 16 years of married life. When 1 week short of term she began to bleed. On examination a breech



TABLE II—MATERNAL AND FETAL MORTALITY  
ACCORDING TO VARIOUS AUTHORS

	Cases	1 cent maternal mortality	1 cent fetal mortality variable and non variable	1 cent fetal mortality variable
M. treuryus				
Schweitzer (collected)	670	5.80	—	7.60
Depken	110	5.50	—	15.50
Braxton Hicks version				
Braxton Hicks version Hospital (Burgess)	71	—	40.00	—
Schweitzer (collected)	1,260	3.40	—	9.10
Rotun Hospital (J. H. H.)	114	4.70	—	—
Hoffmann Abdom. Lomber	18	4.10	—	—
Depken	6	4.00	40.00	—
Duesseldorf Clinic (Schoenholz)	5	5.00	—	15.00
Stratz (personal cases)	110	0.00	14.0	—
Cæsarean section				
Edinburgh Royal Maternity (Watson and Miller)	84	0.00	2.20	—
Kiel Clinic (von Mikulicz Rakowski)	11	1.10	21.90	—
Montreal Maternity Hospital (Burgess)	22	10.70	11.10	—
Karlruhe Clinic (Wagner)	24	1.10	2.0	—
Seigel (collected)	53	1.10	—	6.40
Schulte	5	—	—	12.50
Depken	1	0.00	—	—
Duesseldorf Clinic (Schoenholz)	4	4.10	0.10	6.50
All methods				
Milms (General Hospital (Burr))	145	0	—	—
Charity Hospital (Miller)	70	0.00	51.00	25.00
Karlruhe Clinic (Wagner)	12	0.10	52.00	—
Lebermann	0	1.0	1.55	—
London City Hospital (Egner)	0	10.70	53.00	5.00
New York Living In Hospital (McLennan)	501	8.10	60.00	—
Chicago Living In Hospital	70	1.10	9.00	12.80
Johns Hopkins Hospital (Thomson)	11	10.00	7.00	—
Depken	04	9.10	15.10	—
M. treuryus & Braxton Hicks version extraction after full dilatation				
Schulte	52	5.70	11.14	—
Boston Living In Hospital (Kellogg)	251	8.0	—	—
Vaginal caesarean section				
Do & Klein	150	8.20	—	17.00
No interference or rupture of membranes (mostly in margins/placenta prævia)				
Edinburgh Royal Maternity Hospital (Watson and Miller)	61	1.63	41.00	—
Montreal Maternity Hospital (Burgess)	52	1.0	42.10	—

MATERNAL MORTALITY

Most deaths in placenta prævia result from hemorrhage sepsis or shock. Since the practice of accouchement force has been abandoned, deaths from shock have vanished with it. The 2 patients in this series who were lost, died from sepsis.

CASE 1 Mrs D. Simpson entered the hospital 36 weeks pregnant with a complete placenta prævia. She had been examined twice before admission by her family doctor. She was anesthetized and the cervix found to be 4 fingers dilated. A Voorhes bag was introduced outside the os. After the bag had passed the cervix some hours later the os was found to be fully dilated and the fetus was delivered by version and extraction. The infant weighed 5 pounds 1 ounce and survived. There was no hemorrhage following delivery and the uterus was not packed. The patient developed puerperal sepsis and died on the twenty-ninth day postpartum.

CASE 2 Mrs S. Simpson entered the hospital with a marginal placenta prævia in the thirty-ninth week of pregnancy. The membranes had ruptured outside. The family doctor had examined the patient before admission and had packed the vagina with cotton. At the time of admission the temperature was 102.3 degrees and the pulse 140. A Braxton Hicks version was done and the infant which weighed 6 pounds and 12 ounces and was somewhat myelodorous was later expelled spontaneously. There was no hemorrhage following delivery. A stormy septic convalescence ensued. A gluteal abscess was opened and drained. A sacral abscess was opened and drained and finally a pelvic abscess was incised by vagina and the pus evacuated. In addition to the usual supportive treatment she received two transfusions of 500 cubic centimeters, one on the nineteenth and the other on the thirty-fourth day. She died on the thirty-ninth day of the puerperium.

It is my opinion that the first patient and possibly the second could have been saved had the abdomen been opened, the uterus everted, and a cesarean section with hysterectomy and free drainage done. The principle of removal of the uterus first advanced by Porro has been successfully applied to many infected cases in which the placenta was in its usual situation but which had been subjected to fruitless attempts at delivery from below. With the extra liability to sepsis which is known to exist in placenta prævia there is every reason to employ this method when potential sepsis is present (Table II).

Reported mortality statistics in placenta prævia, like similar figures in any obstetrical condition, should not always be taken at their face value. Most of them are a compilation of the results of a number of operators working in the same institution, but not always under the same policy, and subject to variations in judgment and operative skill. Outstanding among the results published up to the present are those of Stratz (23), who reports the loss of one mother

by the introduction of a foreign body to check the bleeding, such as the vaginal pack or even the metreurynter or by free access to the low lying placental site of the pathogenic bacteria which may be found in the vagina postpartum. Infection is aided by the anemia and lowered resistance of the patient. If, as some advocate, cesarean section should be adopted as the method of choice in placenta prævia, all danger from the bag as a foreign body and the manipulations necessary to bring down a leg in doing a Braxton Hicks version would be avoided, but the other factors would still remain. Since sepsis following caesarean section is considerably more fatal than that consequent to pelvic delivery it is evident that cases to be delivered abdominally must be selected with great care if it is planned to leave the uterus *in situ*.



in 110 cases mostly from private practice which he personally delivered giving a mortality of 0.9 per cent. So far as I am aware this figure has never been equalled in a series of equal size. Practically all of his cases were treated by Braxton Hicks version a convincing argument for the safety of this operation. Without wishing to detract in the slightest degree from the credit due him one cannot help but remark in passing that all omens must have been favorable. It is however noteworthy that his gross fetal mortality was 64 per cent which gives an equally good picture of the usual effect of this treatment upon the infants.

Hospital statistics also vary as regards the type of patients admitted to its wards. The New York Lying In Hospital maternal mortality, 12.1 per cent compiled by McPherson (16), represents a large number of neglected cases already infected or exsanguinated before admission. The clientele of the Boston Lying In Hospital is similar to it. On the other hand the record of the Chicago Lying In Hospital (3) of a maternal mortality of 1.3 per cent in 70 cases of placenta prævia for the 7 years ending in 1905 is understandable in view of DeLee's statement that over three quarters of its patients come from the better classes of society.

A glance through Table II reveals a considerable variation in the percentages of maternal mortality, part of which is no doubt due to some of the factors noted above. However Braxton Hicks version and metureurysis show consistently the best results for the mother and the mortality following the extended use of either should not exceed 5 per cent. Cæsarean section exhibits a slightly higher death rate, the 6.3 per cent mortality in the 528 cases collected by Siegel (2) being probably a fair representation of the true state of affairs. The employment of all methods of delivery shows great variations from 1.3 and 20 up to 60 per cent. This discrepancy does not indicate however that all cases of placenta prævia should be treated in some one way. No one measure cæsarean section Braxton Hicks version or metureurysis is applicable to all patients. In no other situation in obstetrics is the demand for mature judgment more pressing. All factors in every case should be weighed and the individual treated accordingly.

#### FETAL MORTALITY

Of the 57 infants 12 were non viable or dead on admission and 1 was an anencephalic monster. There were 20 viable babies that were stillborn or that died in the hospital. The gross fetal

mortality was therefore 57.9 per cent and the corrected mortality 45 per cent. Since metureurysis and Braxton Hicks version were the methods of choice a high fetal mortality was to be expected. In this series the mortality among viable infants delivered by metureurysis was 41.4 per cent by Braxton Hicks version 80 per cent (Table II).

It is evident that Braxton Hicks version is accompanied by the highest infant mortality and that the selection of this form of delivery practically means the sacrifice of the child. If the fetus is already dead non viable or a monster it need give us no further concern. Therefore in such cases Braxton Hicks version is clearly indicated because it has the lowest reported maternal mortality provided that the patient is uninfected and the cervix sufficiently dilated to admit 2 fingers so that a foot may be grasped. It is also the best operation for the general practitioner without hospital facilities as it requires no special equipment. He should remember, however that having turned the baby its expulsion must be left to nature otherwise he will tear the cervix and is likely thereby to cause fatal hemorrhage.

I cannot agree with the statement of Siegel (2) that cæsarean section is the best treatment for placenta prævia after the thirty second week of pregnancy regardless of whether the child is dead or alive. If the patient is uninfected and the baby dead Braxton Hicks version will in the long run give the best result for the mother. If the patient is potentially infected cæsarean section followed by hysterectomy is the logical procedure. I also for the same reasons disagree with Kellogg's (12) statement that all cases of central and partial placenta prævia are best treated by abdominal cæsarean section whether the baby be viable or non viable living or dead.

#### SUMMARY

1. A series of 57 personal cases of placenta prævia is reported. Two mothers died from sepsis giving a maternal mortality of 3.5 per cent. There were no deaths from hemorrhage.

2. The gross fetal mortality was 57.9 per cent. Eliminating non viable infants monsters and those dead on admission the corrected mortality among viable infants was 45 per cent.

3. The methods of delivery used for the most part were metureurysis and Braxton Hicks version. In no case was the cervix dilated forcibly either manually or by traction on the fetus. Two cæsarean sections were done and one was followed by a hysterectomy.

4 Removal of the placenta by expression was the rule. The uterus was packed 5 times in 7 patients. Avoidance of unnecessary intra uterine manipulation postpartum is desirable.

5 The morbidity rate was 21 per cent.

6 Deaths from hæmorrhage in placenta prævia may be avoided by adherence to three cardinal rules: (1) check the bleeding, (2) restore excessive blood loss by transfusion and (3) respect the cervix.

7 Sepsis is responsible for a considerable number of deaths in this condition. Cesarean section followed by hysterectomy is indicated if the patient is potentially infected.

8 In view of our present knowledge the ideal treatment of placenta prævia may be stated as follows:

If the patient is uninfected and her condition poor from loss of blood she should receive a preliminary transfusion. A Braxton Hicks version should be done forthwith regardless of the state of the infant because it is the quickest way to stop the hæmorrhage.

If the patient is uninfected and her condition good but the baby dead non viable or a monster, she should also have a Braxton Hicks version because it has the lowest maternal mortality and the baby in this case need not be regarded.

If the patient is uninfected and her condition good and the baby alive, normal and of sufficient size to warrant the assurance of survival cesarean section should be done, as in this way the baby will be saved and the mother's life not unduly jeopardized.

Simple rupture of the membranes in marginal placenta prævia is safe for the mother but no better than metrorrhysis for the baby.

If the patient is potentially infected she should be delivered by cesarean section followed by hysterectomy regardless of the state of the baby. If she is in poor condition, a transfusion is given prior to operation.

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## EDITORIALS

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### SURGERY, GYNECOLOGY AND OBSTETRICS

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#### THE GENTLE TOUCH IN SURGERY

THERE are few of the arts and sciences that show in the last 50 years greater changes and advancement than surgery. Speed in operating while always essential for safety and an asset to the operator does not hold the same relation to good results that it did in pre-anæsthetic days. But ask any surgeon himself and he will tell you he prefers for his own person a speedy operator *provided* the man is not rough, is careful and does not omit any of the technical necessities. Is it not painful to watch some operators fussing at their work and spending not only the patient's cash but his vitality over non-essential technical details? Speed in operating comes first from knowledge but chiefly from experience and practice. It stands to reason that after one has performed a thousand gastro-enterostomies his subsequent work will go off with greater dispatch than it did while he was performing his first dozen operations. But there is no escaping that first dozen! There is however an additional element to be considered which is frequently overlooked. That element is

temperament. With this you are endowed at birth. Exactly as some men are quicker at figures than are others and also as some are quick to catch the point of your talk, so some are quicker in their mental processes and their movements. Some are like highly organized racehorses constantly strung up on the *qui vive* and figuratively always working on their toes. They may do this possibly at a wasteful expenditure of energy (to themselves) but these men are often our great surgeons and they deliver the goods."

There is one quality in surgical work that is often forgotten. That quality is *gentleness*. Gentleness before and after the operation is of course in the nature and work of every good surgeon. That goes without speaking. But do we not after our patient is under the anæsthetic and unconscious fail to remember what Crile has for so many years tried to teach us? Yes, surely our patient is asleep. He gives no outward evidence of traumatic injury. But his tissues and nerves are still very much on the job and resent in their own silent but positive way their insult and injury. A stupid surgeon does not see this. He will place a hoe-like retractor in an abdominal wound and pull on it with almost his whole strength and traumatize the edges while pulling the wound apart. It is true the peritoneum is long suffering. It will stand much abuse. It will even be *forgiving* and after the operation is over with the help of God it will even digest a foreign insult. But the wise surgeon remembers that the peritoneum is his best friend. And who would injure his best friend? Watch two men with equal ability

doing the same class of work. Why is it that one gets almost 100 per cent recoveries both as to morbidity and mortality? Why do the edges of a wound with one surgeon show a tendency to slough so that only the perfect technique of his operating nurse will pull him through without a suppurating wound?

It is often necessary to operate upon the living human body. Probably a well performed surgical operation is one of the finest and greatest works of man. Do painting or sculpture, or architecture, business, or even divinity require a nicer or a gentler touch?

It often takes years to teach one just the right amount of tension to put on his sutures. A neglect of this important thing will end in disaster. Who has not seen a hurried and careless surgeon sew up the abdomen as if he were putting a sole on a shoe?

Who as an operator has not sometimes fairly cringed at the rough manner in which an assistant wipes the wound? Do we not know that surgical gauze has a tooth that can bite and tear and scratch?

It takes years to acquire the technique to perform our operations with the *scalpel* and scissors and use as little as is wise and possible what is erroneously called *dry dissection*. The latter is not gentle surgery.

A surgeon is not giving the "gentle touch" when he is doing "stunts." The chief reproach that can be hurled at exhibition operations is that they carry the great temptation to a good man to try to show just how "good" he is. He is working under a strain (although he may not know or acknowledge it). The patient may not get a fair deal.

Without trying to be funny, there is another touch of the surgeon that might be mentioned in passing. That is the touch of his pocketbook. It is an absolutely necessary touch, or else the surgeon would die. Why should this not likewise be gentle? Here,

however, comes the rub. What is almost brutal to one patient for the same job is the quintessence of gentleness to another. But notwithstanding the wealth of our patient, we never were bright enough to understand the *comparative* justification in charging from one thousand dollars to two thousand dollars for the removal of the tonsils. There is absolutely no specific instance in the writer's mind, it is only spoken of casually as an example. But there are more like it.

Now the welfare of the patient is our first consideration, not the welfare of our pockets, or our fame as an operator. In order best to conserve that welfare in our surgical work, we must always keep in mind that every wound of the human body is like a sensitive plant. It responds to gentle treatment and resents brutality. It is, moreover, in our own interest to be gentle, for we shall find that we get full compensation for value received. Our wounds will heal better, our results will be better, our reputations will be better, and we shall have better satisfaction with ourselves and our work.

In a few words, therefore, we should be gentle men! JOHN HAMMOND BRADSHAW

## EARLY DIAGNOSIS IN CASES OF TUMORS INVOLVING THE SPINAL CORD

THE promise of Horsley and Gower's work in 1888 has been fulfilled in recent years and improvement in surgical operations on the spinal cord has made rapid strides toward success never dreamed of by these pioneers. The mortality following laminectomy at any level of the spinal axis is lower than it has ever been and results following removal of tumors encroaching on the cord have at times seemed miraculous. Exploration of the spinal canal at any given level is resorted to with much less fear and with more

confidence it is probably not performed often enough when there is cause to suspect a removable lesion. Greater surgical risks are being faced and convalescence after the operation has been shortened. Nevertheless there remains the most important element in the prognosis in a given case of compression of the spinal cord by a benign tumor, namely the stage at which the condition was recognized and accordingly the degree to which the cord has already been injured. The most brilliantly performed surgical operation can return only as much function to the cord as nature will concede following the removal of pressure; this depends on the length of time it has been present. It is probable that even today many cases of tumors involving the spinal cord are doomed to be unrecognized or worse still to be operated on because of some other supposed condition.

A plea is therefore made for early recognition of this disease so that it can be remedied by the very efficient surgical measures now being employed.

The present methods of diagnosis may be considered under two headings, clinical and mechanical. Clinical methods consist of careful history taking, complete physical and neurological examinations and possibly hours of patient checking of the motor reflex and sensory functions in the area involved. Mechanical aids to diagnosis that have been developed during recent years are the Queckenstedt test, Ayer's differential spinal and cisternal punctures and the use of 40 per cent iodized oil as suggested by Forestier and Sicard. The older clinical methods are by far the more important, are less subject to fallacies, and not only aim at establishing the nature and exact situation of the cord lesions but also lead to an investigation of the patient as a whole. Further, in spite of all the modern mechanical aids that we possess, this exami-

nation of a patient with our five senses cannot be dispensed with.

As a support to the preliminary clinical examination, the Queckenstedt test is simple in its application and extremely valuable in the information it supplies. In all cases in which tumor in the spinal canal is suspected spinal puncture with compression of the jugular veins and manometric readings should be carried out. Failure of the spinal fluid pressure to respond means a block in the subarachnoid space. The spinal fluid itself has been found to be changed in its physical characteristics below such a block. It may be yellow, coagulate on standing and have a high content in protein (Froin syndrome). Ayer's differential spinal and cisternal punctures represent a further elaboration of the Queckenstedt test and samples of fluid may be obtained and changes in its pressure recorded at various levels above and below the site of the tumor. The use of these differential punctures is of more value when the physical signs are few or misleading, particularly in the case of tumor in the lower dorsal, lumbar, and sacral regions.

With the advent of 40 per cent iodized oil it was hoped that all problems of diagnosis and localization of the lesions would be solved and in a mechanical and busy age it seemed simplicity itself to inject this substance into the subarachnoid space either above or below the tumor and to locate it directly by the fluoroscope or roentgenogram. Further it was hoped thus to avoid long and tedious hours of history writing and sensory tests. Unfortunately the drug has been found to possess its own particular fallacies and disadvantages and it now has a much more limited application than was originally hoped for. When clinical examination and differential spinal and cisternal punctures have failed to identify the tumor, or determine its site, 40 per cent

iodized oil can then be used, but the results must be interpreted with due caution. The most perfect results obtained from its use are in cases in which there is a large tumor, a complete block of the subarachnoid space and consequently such marked physical signs that the test is hardly necessary except as confirmation. However there will always be a small percentage of cases regarding which reasonable doubt exists even after all other methods have failed. This new procedure therefore, may be regarded as one more aid in the diagnosis and location of growths within the spinal canal.

Increasing surgical skill has made the chapter on spinal cord tumors much more happy reading and a new incentive has been created to separate from the vast medley of incurable diseases of the spinal cord this condition that can be remedied. In the whole realm of medicine there is probably nothing so encouraging and inspiring as our recently acquired ability to restore to normal existence those unfortunate persons who otherwise would be doomed to drag themselves through life crippled, paralyzed and incontinent, dependent on the care of others and useless to society.

H. L. PARKER

# MASTER SURGEONS OF AMERICA

## JOHN HOMANS

JOHN HOMANS, a distinguished abdominal surgeon of New England, and a pioneer in the use of ovariectomy in this part of the country, was born in Boston, Massachusetts December 26, 1836. He was the third in direct succession to bear the name. His grandfather John Homans, who graduated from Harvard College in the Class of 1772, was an army surgeon during the Revolutionary War. He died in 1800 leaving a son, John Homans, who graduated from Harvard College in 1812, received the degree of M.D. in 1815, and practiced medicine in Boston until he died in 1868.

John Homans the subject of this sketch, graduated from Harvard College in 1858 and received his medical degree from the Harvard Medical School in 1862. He then entered the Massachusetts General Hospital as surgical interne.

His attention was first directed to the operation of ovariectomy by an autopsy which he performed about the year 1860 on a woman who had died with two large ovarian tumors from which during life she had greatly suffered on account of pressure and dropsy. The experiences and opinions of certain English surgeons furnished added inspiration. He had intended to pursue the matter further, but the Civil War kept his thoughts for 4 years in another direction.

When the Civil War broke out he volunteered for service in the United States Navy, was commissioned assistant surgeon, and served on the *Acrostook* for 6 months, but, although he was much impressed by the care and method of the naval service he found the confinement on a small vessel irksome and he had little or no surgery to do there. Finally he succeeded in being appointed assistant surgeon in the regular Army and was ordered to New Orleans where he was assigned for service at the St. James Hospital. To quote from his autobiography<sup>1</sup> "My duties at the St. James Hospital were very congenial. I had several wards under my care. The cases were mostly affections of the bowels or chills and fever, or malaria in some form with debility, homesickness and feebleness from age, the sufferers having understated their age when enlisting. Almost all the members from a Rhode Island battery that came to the hospital were over sixty."

<sup>1</sup> From the address of Dr. George B. Shattuck to the memorial meeting of Dr. John Homans held at the Massachusetts Medical Society, Boston, December 26, 1903. This quotation is taken from the biography of Dr. Homans which has been arranged by the author as a first part of his autobiography. It is pointed out that Dr. Homans did not believe in the necessity for being very kindly interested in army life and of observing themselves.



JOHN HOMANS  
1836-1903





Although, during his service in the army he naturally had a large number of varied and instructive experiences it would hardly be appropriate even to enumerate them here. One of his cases, however, is given at length in his own language.

"I had watched another middle aged man who had been hobbling about the hospital, bent over and leaning on a stick for about 3 months. He said he had the rheumatism in his back and that he could not stand up straight or do any duty. It seemed to me that the man had better be cured and returned to duty, or discharged. There was no reason why the government should be paying for a man who was of no use. One morning I sent for the sergeant of the guard and told him to send me a strong sensible man who could use some judgment in a case for which I should detail him. He sent me a tall Yankee belonging to a New Hampshire regiment.

"I instructed the man to take the afflicted one on to the veranda, to take away his stick and to order him to walk up and down the veranda—if he stopped to prod him with his bayonet. I explained to the patient that I was anxious for his good and wanted to see if I could not cure him. He agreed that it was a sensible plan. In about ten minutes the soldier reported that the patient was walking on the veranda, but was sweating profusely and seemed quite tired. I said 'Let him up for a few minutes and then keep him going according to your judgment till dinner time, and then take him out again for an hour or so after dinner.' In the afternoon the soldier and the patient reported. The sick man was walking perfectly well and the next day was returned to his regiment. I thought if the man was malingering he would soon repeat the process and get into another hospital. In the autumn of 1864, while surgeon in chief of the first division of the 19th Army Corps in the Shenandoah Valley in Virginia, I was hailed by a man on a mule, driving an army wagon. 'God bless your honor, I hope you are well.' 'Very well,' said I, 'and who are you?' 'I am the man you cured of rheumatism in New Orleans, God bless you.'"

In May, 1865, Dr. Homans resigned from the army, after a service, in army and navy together, of somewhat over 3 years.

Not long after leaving the army he went to Europe, where he passed most of his time in studying in Paris and Vienna, and in traveling. He then returned to Boston, November, 1866, and began the active practice of his profession. Within a reasonable period he built up a good family practice, but, as time went on, he was drawn more and more into surgery, of which ultimately he made a specialty, being one of the first physicians in Boston to do so. His experience in the army and navy was an excellent preparation for the life he had chosen, for, while he was in the army he had charge, from time to time, often in the midst of great emergencies, of large numbers of medical and surgical patients for the proper care of whom he was responsible, and, therefore, there were frequent

opportunities for the exercise of rapid judgment and decision in all kinds of cases, as well as for practice in the various operative procedures. He was soon appointed surgeon to the Boston Dispensary, and some years later surgeon to the Children's Hospital and finally to the Carney Hospital.

It was at the Carney Hospital where he began his long career as an abdominal surgeon that in 1872 he did his first ovariectomy. In 1873 he did a second ovariectomy and in 1875 a third and a fourth. *His first successful ovariectomy was done in 1877.* Carbolic spray was used for the first time in this operation. The next 4 patients recovered, the spray being used at each operation. That he should have 5 successful operations with carbolic spray after a number of deaths without the spray made on Dr. Homans's mind a firm impression and, although in time in October, 1887, he gave up the antiseptic method for the aseptic one, he did so with the greatest reluctance. He performed many other ovariectomies at the Carney Hospital where in 1880 he was made consulting surgeon.

Later he did his operations at St. Margaret's Hospital and his cases, of which he always made a careful study, rapidly increased in number. Many were sent to him from different parts of New England, as well as from Boston and many also from the Provinces. Between 1872 and 1900 he performed 601 ovariectomies, and it is noteworthy that as his experience increased his results grew better and better.

His operations were by no means confined to ovariectomies for he not infrequently opened the abdomen for other purposes. In April 1881 he began to do abdominal hysterectomies. He was also one of the first surgeons to operate for abscess of the appendix. Many of the details in the operative technique of ovariectomy and hysterectomy in use today and this statement also applies to certain operations in other parts of the abdomen, were originally devised by Dr. Homans.

Early in his abdominal work Dr. Homans was appointed surgeon to outpatients at the Massachusetts General Hospital. Not long after this he entered the house as visiting surgeon. At that time abdominal surgery was looked upon as a specialty. By long established precedent the introduction of specialties into the hospital was not looked upon with favor. For this reason the introduction of abdominal surgery into a general hospital met with some opposition. It is hard to realize that within twenty years abdominal surgery was regarded at the Massachusetts General Hospital as a specialty—a hospital in which more than one thousand abdominal operations were performed in 1901 and 1902!"

As an operator he was conscientious, painstaking, fearless and usually calm although somewhat excitable when in a tight place. Occasionally, however, he

would have his joke for he had a strong sense of humor. He took the best of care of his patients after an operation, sparing himself no pains to give them a better chance for recovery and to make them more comfortable. It may be mentioned that he had been heard to say that the best way to get patients is to take good care of those you already have.

The success of his operations and the earnestness and enthusiasm with which he did his work attracted the attention of the entire profession in this vicinity, and many young men witnessed his operations or followed his cases with intense interest among them being such well known surgeons as Dr. Maurice H. Richardson and Dr. Arthur T. Cabot. He always kept a list of those persons who were interested in his work and after he had made all his arrangements for the operation, he had a notice sent to each one of them. Later some of these young men, stimulated by his example not only had their own cases of ovariectomy but applying his methods extended the area of their own operative procedures to the remotest parts of the abdomen.

Although most of his time was taken up with operating and in attending to his cases he still was able to do a good deal of writing and from time to time medical or surgical articles from his hand appeared in the medical journals. In 1887 he published a very important one entitled 'Three Hundred and Lightly Four Laparotomies for Various Diseases.'

In 1881 he was appointed clinical instructor in the diagnosis and treatment of ovarian tumors in the Harvard Medical School and for years he lectured there on that subject. Early in his career he gave a regular quiz course in anatomy (extramural) and this was continued for many years. He was a member of the American Surgical Association, of the Society of the Cincinnati, of which his grandfather was a founder and of the order of the Loyal Legion. He was also the medical examiner of the New England Life Insurance Company.

He died, after a short illness at his home in Boston February 7, 1903 in his sixty sixth year, leaving a widow and six children, three sons and three daughters. One son who bears his name is at present a practicing surgeon in Boston.

Three years after his death the John Homans Professorship of Surgery was established in the Harvard Medical School by his friends and associates. This was indeed a fitting memorial!

In the large number of successful operations which he performed Dr. Homans made a definite contribution to the world, but the real value of his services was especially demonstrated by his leading the way in the development of one of the major operations of the abdomen, and also, by his example, in furnishing the incentive to others to follow in his footsteps.

Members of the medical profession had a great respect for Dr. Homans, and they had a full appreciation of what he had accomplished. He was familiarly

and affectionately referred to as "Uncle John" or as "Honest John Homans" It is refreshing to record the life of a man who possessed so many admirable characteristics His intelligence persistence and courage, his modesty, cheerfulness, and strong sense of humor, when added to those good qualities already referred to or suggested, combined to make a personality which is as rare as it is attractive

GEORGE H MONKS

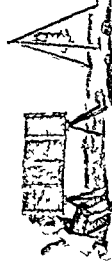


THE  
ANATOMY  
OF THE  
HUMAN BODY

BY  
W CHESELDEN  
Surgeon to his Majesty's *Regiment Hospital* at CHELSEA  
Fellow of the ROYAL SOCIETY

And Member of  
The *Royal Academy of Surgeons* at PARIS

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# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

BY ALFRED BROWN M.D. F.A.C.S. OMAHA, NEBRASKA

### CHESLEDEN'S ANATOMY OF THE HUMAN BODY

THE rehabilitation of the teaching of anatomy and surgery in England was due in great measure to William Cheselden. During the seveneenth and early part of the eighteenth century surgery in England was in a sorry plight. The usual method of training surgeons was by apprenticeships and when trained they had difficulty in separating themselves from the barbers. Teaching in London was carried on in St. Bartholomew's and St. Thomas's Hospitals where the apprentices served seven years and no definite courses were given. The act of 1540 uniting the surgeons and barbers in a single group was still in effect and the two groups were almost indistinguishable to the lay, the barbers acting like a millstone about the necks of the progressive and ambitious members of the surgical group. Finally in 1702 the Governors of St. Thomas's Hospital passed a ruling forbidding pupils or surgeons to dissect without the permission of the treasurer and a year later the number of apprentices to any surgeon was limited to three.

About this time Cheselden appeared on the scene. He was born at Somerby, Leicestershire in 1688. He first studied under a surgeon in Leicestershire and later under the anatomist William Cowper in London, and the surgeon Iern in St. Thomas's Hospital. In 1718 he was appointed an assistant surgeon at St. Thomas's and in the following year was promoted to be full surgeon. The statement is made by most of the authorities that the first edition of his *Anatomy of the Human Body* was published in 1713, so in the copy illustrated here, which is the sixth edition, the date MDCCXII (1712) must be a misprint and probably should read MDCCXXII (1722). In the title page, Cheselden does not refer to his connection with St. Thomas's, but describes himself as "Surgeon to his Majesty's Royal Hospital at Chelsea, Fellow of the Royal Society, and Member of the Royal Academy of Surgeons at Paris." When St. George's Hospital was founded in 1733, he became one of its surgeons. He died at Bath, England in 1752, living long enough to see the disassociation of the surgeons and barbers for which he had striven all his life and which took place according to Act of Parliament in 1745.

Cheselden began to teach anatomy, and with it surgery, at St. Thomas's in 1720. His book although

entitled *The Anatomy of the Human Body* is also in great part surgical for in it he refers constantly to what might be called surgical physiology and in places refers to surgical operations. One of Cheselden's great triumphs was his operation for the formation of an artificial pupil by iridotomy which he describes as "A knife pressed through the tunica sclerotica under the cornea before the iris in order to cut an artificial pupil where the natural one is closed." This operation I have performed several times with good success indeed it cannot fail when the operation is well done and the eye no otherwise diseased which is more than can be said for couching a cataract. In this operation great care must be taken to hold open the eye lids without pressing upon the eye for if the aqueous humour is squeezed out before the incision is made in the iris the eye grows flaccid and renders the operation difficult. He also describes an operation for excising a portion of a proptosed cornea and says "This operation is very useful and attended with but little pain."

Cheselden's other great success was in cutting for the stone. In this he was supposed to be supreme and great stories of his exploits in this operation were told. He is said to have removed a stone by lithotomy in fifty four seconds. He was at first an exponent of the high operation but later changed to the lateral perineal section, and improved greatly on the method of Frere Jacques. He writes in his anatomy a chapter on the history of cutting for the stone and in it tabulates his results in both types of operation. In the high operation (suprapubic) he lost no more than one in seven. In his public practice at St. Thomas's he cites two hundred and thirteen cases of perineal section with a mortality as follows: of the first fifty only three died of the second fifty three, of the third fifty, eight, and of the last sixty three six. The reason why so few died in the first two fifties was, at that time very few bad cases offered in the third, the operation being in high request, even the most aged and most miserable cases expected to be saved by it.

One of the charming points of this sixth edition is the beautiful copper plates engraved by Gerard Vanderghucht some of which are dissections in the poses of famous statues. The frontispiece represents, according to the author, "the story of Hippocrates going to cure Democritus of madness but finding him dissecting to discover the seat of the Bile, he pronounced him the wisest man in Abdera."



## REVIEWS OF NEW BOOKS

**M**ALARIA is the oldest disease of which we have any reliable record and the most widespread disease in the world today. The paroxysm is largely a neurological phenomenon and very few known nervous system syndromes are absent from the list of conditions arising from malarial infection. So far as the nervous system is concerned, sequels to infection fall into four groups: acute cachexia, spontaneous recovery or recovery with quinine, and latent forms in which the parasite may live for years in spleen or bone marrow and emerge only occasionally. Like syphilis, malaria may affect any organ or tissue of the body, but has a strong predilection for the nervous system.

Dr Anderson<sup>1</sup> presents in a recent volume an enormous amount of original and collected material in a very concise form with extensive tabulation case histories and an unusually complete bibliography filling 35 pages. There are a number of good illustrations and four excellent colored plates illustrating brain changes in cerebral malaria.

This volume is the first comprehensive work on the neurological aspects of malaria and is a most valuable contribution. JOHN FAVILL

JOHN FAYILL

A SMALL volume of 200 pages covers the problem of therapeutic malaria<sup>2</sup> in a painstaking manner. A bibliography is appended covering 400 articles which are constantly referred to in the text. As the author says, general paralysis is a disease in which it is difficult to gauge the value of any treatment the difficulty being due to the spontaneous remissions which may occur. Nevertheless if a fraction of the apparent cures are actually attributable to the malaria treatment it should be given a fair trial. The mortality attached to this procedure is frankly presented and analyzed. It is said to be from 2 to 6 per cent. The technique, course and results are well described. This is a valuable work describing a promising new form of treatment for general paresis.

PAUL STARR

PAUL STARR

FEDERSPIEL'S ideas of and his experience with cleft lip and palate with a report of 15 cases have been published in book form. The first chapter contains a good outline of the history, cause and development of clefts three plates of monstrosities with associated cleft lips and probably palates and the deformities resulting from the

**Brophy palate operation** The second chapter covers the anatomy and physiology

Several different methods of harelip operations are outlined including one of the authors for single clefts. The general principles are well laid down and the drawings are clear cut. The author believes that lateral incisions for making palate flaps are unnecessary and cause scar tissue contraction of the soft palate although they may be made if there is still too much tension after the author's tension plates are in.

Under the non surgical treatment of cleft palate is a very complete description of various types of appliances and the methods of taking impressions for them. For cases in which a complete closure is impossible the author closes any available part of the soft palate and the posterior pillars by freshening the edges drawing them together and suturing them in the midline and then releasing tension by incisions into their substance just below the last suture. The hard palate cleft is then closed with an obturator

BARRETT BROWN

A LITTLE book\* by May on diseases of the eye has gone through so many editions and has been translated into so many languages that it needs no introduction to ophthalmologists. If it is possible to write a book on a specialty for the benefit of students and general practitioners then this little volume fulfils the demands of the almost impossible. The twelfth edition contains much information in an easily accessible and very concise manner. All controversial material has been left out and only well established practice advocated.

VIRGIL WESCOTT

THE study of angrina pectoris<sup>1</sup> by Coffey Brown and Humber was stimulated originally by the publication in 1900 of Jonnescu's first operative case. Since making the report of the first series of 5 cases some 30 additional patients have been operated upon by Coffey and a number have been treated by their method and are reported in the present book. The cases are very completely reported and form a mass of instructive material.

The authors conceive of angina pectoris as a spasm of the aorta and coronary vessels which causes death by producing a cardiac asthenia their view in this case coinciding with that of Danielopolu

The surgical treatment is given in considerable detail illustrated by many full page plates with explanatory pen and ink sketches. This is true also

MALARIAL P YCHOSIS AND N R S WITH CHAPTER S ON THE M D  
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G E R A T I O N A L C H O AND T R C Y B y W H H A D n M D  
F R E P S (G I ) N w y k O f d C t y P 97

THERAPEUTIC MALARIA B G d M R d H M R C S L R C P  
 DPH DPM NwY k Of dU tyP 97

HA ELIP AND CLE T PAL (HE LO CHI URAN CHI AND STA  
PHYLONCH IS H STO Y ETI OGY DE LOPME T AN T MY PHYS  
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CA S By Math w N F de p i B S D S MD f ACS  
FACD St Lo C V M by C mp y 937

MANUAL OF THE DISEASES OF THE EYE  
 PRACTITIONER By CHAS. H. M. Y. M. D.  
 W. H. Wood & Co. N. Y. 1897

ANGINA PECTORIS THE ANA MY PHYSIOLOGY AND SURGICAL TREATMENT By Wm H B Chaffey M D FACS Philadelphia G B W A B M D and John D von Humboldt BS M D New Orleans A J D K 07

of the gross anatomy of the sympathetic system both craniosacral and thoracolumbar.

The apparent presence of pain conducting fibers in the superior cervical sympathetic ganglion and sympathetic trunk is a distinct addition to the knowledge of this subject.

The book is essentially a collection of data from which one who will may derive a considerable amount of information. It is not written in any dogmatic fashion and credit is given to many sources from which the authors have obtained information. The problem of cardiac pain and the question of the production of angina pectoris and the rationale of the present surgical treatment are still mooted questions which will bear further study.

MICHAEL L. MASON

**DANILFLOPOLU**, professor of clinical medicine at Bucharest and director of the institute of clinical medicine at the Filantropia hospital has written on the subject of angina for the past 30 years and although not a surgeon himself has contributed much to the establishment of correct principles in the surgical treatment of the condition. His recent monograph represents the culmination of many years of clinical observation and experimental study. It is written from the standpoint of the physiology of the vasomotor system especially that of the cardiac nerves. Although developing his own ideas and citing experimental evidence and clinical facts in support of them, he considers critically all other theories and hypotheses that have been advanced in explanation of the condition. It is the most complete and thorough monograph extant on the subject.

The book covers the definition and classification of the anginal syndrome, its symptomatology, clinical course, diagnosis, etiology, pathology and pathogenesis, and treatment. The author believes that angina of both the chest and abdomen is produced by an analogous mechanism that is an ischemia of contractile tissues (the cardiac muscle in the one instance, smooth muscle of the gastro-intestinal tract in the other), the predisposition to which being nearly always an obstructive arterial lesion. He divides angina pectoris into two large groups: the uncomplicated and the complicated. The uncomplicated type he further divides into the organic and the inorganic and the complicated into those with dyspnea during the attack and those in which the respiratory embarrassment to an acute pulmonary oedema. In regard to inorganic angina pectoris the author says: "The production of an anginal attack, although most often favored by an organic lesion, is nevertheless a functional trouble due to insufficient vascular supply to the myocardium which may occur without any organic lesion whatsoever. The attack of angina is to our mind a phenomenon of myocardial fatigue in many ways similar to fatigue of voluntary muscle due to a poisoning of the sen-

sory and motor endings of the myocardium by the products of fatigue. This condition is caused by an insufficient vascularization of the myocardium, a phenomenon which leads to a pressor reflex circle." The object of operative treatment should be to abolish the vicious pressor reflex which the author believes can be done without danger by a rather simple surgical procedure. In his operation he takes into consideration the fact that the heart requires its nerve supply in order to function properly. He condemns the ruthless removal of nerves without an understanding of their possible function.

MICHAEL L. MASON

**WITHIN** the narrow limits of a 61 page brochure H. Hartmann and his collaborators attempt a description of the early signs and symptoms of malignant disease as it affects the various organs and tissues of the human body. Biopsy illustrations of some of the lesions are given. The booklet is to be recommended in that it helps to focus the attention of the general practitioner upon the problem of the early recognition of malignant disease.

GEORGE HALPERIN

**THE** volume on cancers of the breast by Delbet contains 340 pages and a number of splendid drawings from histological preparations. The book represents the results of careful clinical and microscopic studies the aim of which was to correlate the two in an effort to obtain prognostic criteria. It is a fact well known to every surgeon that very early cases may prove rapidly fatal in spite of early and radical intervention and reversely, apparently far advanced cases may survive for years. Just what constitutes the difference in the relative malignancy of a given breast cancer is what the authors are attempting to establish through their painstaking histological studies of the various forms of breast cancers.

These investigations have convinced Delbet that there are two fairly readily recognizable groups: one of relative benignancy, the other of frank malignancy. To the relatively benign group belong the secreting epithelioma, epithelioma characterised by clear cells, these latter least malignant of all, and pavement carcinoma, rare in themselves, rather benign. In the malignant group belong epithelioma of the hæmophilic type, epithelioma consisting of independent cells and third, large cell epithelioma. The last type of growth is rapidly fatal.

In his own work Delbet was able to establish a correct prognosis in 70 per cent of his cases. On the whole the work is a valuable contribution to our knowledge of the subject and should prove of interest to the surgeon and pathologist alike.

GEORGE HALPERIN

\*DIAGNOSTIC DES PRINCIPAUX CANCERS. By Henri Hartmann. Paris: Masson et Cie 1927.

\*LES CANCERS DU SEIN. By Pierre Delbet and Mendaro. Paris: Masson et Cie 1927.

11. ANGINE DE POITRINE ET L'ANGINE ABDOMINALE. By D. Danilfopolu. Paris: Masson et Cie 1927.

THE recent translation of Racht's work on gastroscopy<sup>1</sup> was read with much interest. It must be conceded that the art and science of gastroscopy is far from a state of perfection yet the way has been lighted. The high degree to which bronchoscopy and intrabronchial instrumentation have been developed leads one to the conclusion that gastroscopy is still in its infancy.

The author describes the instrument and technique perfected by Bensaude adding his own experience and modifications. The material is scant the technique is difficult and the results are far from conclusive yet the aim is in the right direction. It is quite apparent that many obstacles and difficulties confront the practitioner of this art because of the position and character of the gastric pouch but it is sincerely hoped that these pioneers in this most interesting branch of diagnosis will not lose courage and will continue their endeavors. J. A. WOLFER

ABOUT 12 years ago Fischer published a book on cystoscopy the many urological advances since that time make Macalpine's *Cystoscopy*<sup>2</sup> all

PRACTICAL CYSTOSCOPY By J. Racht M.D. N.Y. W. B. Saunders Co. 1927.  
(5 CUPS) A. H. C. T. AL AND P. ACTICA. H. A. D. OOK. By J. A. W. B. Macalpine F.R.C.S. N.Y. W. B. Saunders Co. 1927.

the more timely Macalpine covers the history of cystoscopy the mechanics of a cystoscope the lens system the pitfalls of cystoscopes and how to trace and correct their faults the normal bladder (the basis of cystoscopy) the modern interpretation of all forms of cystitis urinary tuberculosis syphilis bilharziasis trabeculation and diverticula. The cystoscopy of bladder tumors is described unusually well and is made attractive by the inclusion of a description of the technique of per urethral diathermy treatment.

The chapter on cystoscopy in prostatic hypertrophy its indications and dangers answers many questions which occur to those using the cystoscope infrequently. Attention is drawn to alterations in the bladder due to pregnancy uterine displacements and tumors of the uterus vesical and ureteral calculi foreign bodies in the bladder ureterocele and the technique of instrumentation are described from the viewpoint of management principally. Cystoscopy in diseases of the kidney something still too little thought of by the general surgeon is discussed concisely and evaluated.

This book is highly recommended to anybody who is interested in the study of cystoscopy.

HARRY CULVER

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**SURGICAL DISEASES OF THE GALL BLADDER, LIVER AND PANCREAS AND THEIR TREATMENT.** By Moses Behrend. M.D. F.A.C.S. Philadelphia: J. A. Davis Company, 1927.

**INSTITUTION OF THE ANUS AND RECTUM.** By Charles John Drueck. M.D. F.A.C.S. Philadelphia: F. A. Davis Company, 1927.

**BEITRÄGE ZUR KENNTNIS DER KÖNIG ITALIEN HALS KISTELN UND ZISTEN.** By P. L. A. Nylander. Jena: Gustav Fischer, 1927.

**A TEXT BOOK OF GYNECOLOGY.** By James Young. D.S.O. M.D. F.R.C.S. (Ldin.) 2d ed. New York: The Macmillan Company, 1927.

**THE SCIENCE AND PRACTICE OF SURGERY.** By W. H. C. Romanus. M.A. M.B. M.Ch. (Cantab.) F.R.C.S. (Eng.) F.R.S. (Ldin.) and Philip H. Mitchiner. M.D. M.S. (Lond.) F.R.C.S. (Eng.) vol. 1—General Surgery, vol. 2—Regional Surgery. New York: William Wood and Company, 1927.

**GONOCOCCAL INFECTION IN THE MALE.** By Abr. L. Wolbarst. M.D. With a chapter written by J. E. R. McDonald. D.P.C.S. St. Louis: The C. V. Mosby Company, 1927.

**EMERGENCIES OF A GENERAL PRACTICE.** By the late Nathan Clark Morse. A.B. M.D. F.A.C.S. Revised and rewritten by Amos Watson Colcord. M.D. 2d ed. St. Louis: The C. V. Mosby Company, 1927.

**MINOR SURGERY.** By Arthur F. Hertzler. M.D. F.A.C.S. and Victor F. Chesky. A.B. M.D. F.A.C.S. St. Louis: The C. V. Mosby Company, 1927.

**NASAL NEUROLOGY, HEADACHES AND EYE DISORDERS.** By Greenfield Sluder. M.D. F.A.C.S. St. Louis: The C. V. Mosby Company, 1927.

**AU SEIN DE LA CHIRURGIE.** By Emile Fergue. Paris: Gaston Doin, 1927.

**A TREATISE ON ORTHOPEDIC SURGERY.** By Royal Whitman. M.D. M.R.C.S. F.A.C.S. 8th ed. Thoroughly revised. Philadelphia: Lea & Febiger, 1927.

**SURGERY: ITS PRINCIPLES AND PRACTICE FOR STUDENTS AND PRACTITIONERS.** By Astley Paston Cooper Ashhurst. A.B. M.D. F.A.C.S. 3d ed. Thoroughly revised. Philadelphia: Lea & Febiger, 1927.

**MANUAL OF SURGERY (ROE AND CARLESS) FOR STUDENTS AND PRACTITIONERS.** By Albert Carl. M.B. M.S. (Lond.) F.R.C.S. and Cecil P. G. Wakeley. F.R.C.S. (Eng.) F.R.S. (Ldin.) 12th ed. New York: William Wood and Company, 1927.

**INTERNATIONAL CLINICS: A QUARTERLY OF ILLUSTRATED CLINICAL LECTURES AND ESPECIALLY PREPARED ORIGINAL ARTICLES ON TREATMENT MEDICINE SURGERY ETC.** Edited by Henry W. Cattell. M.D. with the collaboration of others. Vol. in 37th Series. 1927. Philadelphia and London: J. B. Lippincott Company, 1927.

**THE TONGUE AND ITS DISEASES.** By Duncan C. L. Fitzwilliams. M.B. M.D. Ch.M. F.R.C.S. (Ldin. and Eng.) New York and London: Oxford University Press, 1927.

**THE ESSENTIALS OF OTOTOLOGY.** By George Birmingham McAlhuff. A.B. M.D. F.A.C.S. New York and London: Oxford University Press, 1927.



# CORRESPONDENCE

## THE TREATMENT OF OSTEOMYELITIS

To the Editor In his article on The Treatment of Osteomyelitis in the October 1927 issue of SURGERY GYNECOLOGY AND OBSTETRICS Dr H Winnett Orr makes the following statement on page 452

Delay in providing adequate drainage for the infected bone areas is a common defect in the treatment of osteomyelitis. The teaching has been prevalent that the bones are not to be opened until sufficient involucrum has formed to give strength to the diseased extremity and until complete sequestrum formation has occurred. There is a certain period in the progress of an osteomyelitis when the advice to wait for this condition to come about may be correct. Too often however this counsel has been adhered to for many weeks when the patient suffers during the whole period for lack of drainage.

The context in which this paragraph appears conveys the impression that I recommend delay in acute osteomyelitis. The conservative methods that I counseled in my article I limited very definitely to chronic osteomyelitis. For acute osteomyelitis I too recommend prompt and adequate drainage of the bone. And in chronic osteomyelitis I said "one should provide if need be adequate drainage through the soft parts but if there is no actual sequestrum present he should delay further procedure until it has developed."

WALTER M BRICKNER

New York

To the Editor Dr Brickner has kindly submitted to me a copy of his letter. I regret that I did not make myself quite clear in my article. Dr Brickner and I are quite in agreement as to the importance of drainage in acute osteomyelitis. My early drainage operation is somewhat more radical than has usually been recommended.

It is precisely in the early chronic case however that I recommend extensive drainage (before sequestrum formation) especially if the patient is running a septic course. There need be no delay for the formation of sequestrum or involucrum; indeed that entire process, septicemia and the whole series of late osteomyelitis symptoms and sequelae may be avoided. Then following the drainage operation if the diseased part is carefully immobilized in correct position and the wound left

alone so that there is neither direct nor indirect secondary or mixed infection the patient will have a short and uncomplicated convalescence.

H W ORR M D

Lincoln Nebraska

## TWENTY-FIVE THOUSAND FOUR HUNDRED TWELVE PLUS STONES IN ONE GALL BLADDER

To the Editor What is the largest number of gall stones removed at one operation is a question a number of years ago after removing over 4000 in one case. I looked the matter up to a limited extent and have been under the impression that I found a record of 17000 but recently in looking the matter up again I was unable to verify that impression. Most writers content themselves with the statement that the stones may vary in number from one to hundreds.

Moynihan in his work on Gall Stones reports 1883 as the largest number that he himself had ever removed, these stones being of the average size of a mustard seed. He credits French with 1950 Dunlop with 2011 Hoffman with 5646 Langenbuch with 4000 Naunyn with 5000 and Otto with 7802.

August 10 1927 Mrs D S age 39 mother of seven children the youngest aged 5 years presented herself with a large amount of pelvic pathology and also with the usual symptoms of disease of the gall bladder. At operation next day (an abdominal panhysterectomy) examination of the gall bladder showed it to be quite large and to contain many stones. Nine days later the patient being in excellent condition I did the usual cholecystectomy. The gall bladder was found thick walled filled with thick bile and containing innumerable gall stones. Large numbers of these stones under the supposition that they were merely sand were lost in freeing them from the tenacious bile but a count of those that were saved gave a result of 25,412. Probably not less than 5000 had been thus lost.

These stones vary considerably in size all are round and of a uniform brown color with a polished surface as though varnished. The larger have a diameter of one eighth inch and the smallest a diameter of about one half that but examination of the smallest with a reading glass shows each to be a perfect gall stone precisely like the larger ones except in size.

The patient made an uninterrupted recovery.

J F BALDWIN

Columbus Ohio

1 Submitted Sept. mber 27 9 7

B kne W M Attenu ted bo 1 f t J Am M A 9 5  
December 5

# SUTURE OF THE FACIAL NERVE WITHIN THE TEMPORAL BONE

*To the Editor* In the July, 1927 issue Dr Sterling Bunnell of San Francisco published an article on 'Suture of the Facial Nerve within the Temporal Bone' with a report of a first successful case.

In May, 1922, Dr K. Winfield Ney of New York City published in the *Laryngoscope* the technique of an operation for the direct repair of the facial nerve entitled 'Facial Paralysis and the Surgical Repair of the Facial Nerve.' This procedure is a repair of the facial nerve in the facial canal with a technique similar to that referred to by Dr Bunnell. Previous to publishing this article Dr Ney had successfully operated upon three cases of facial paralysis in which he used this technique. Since then he has operated upon many others. I have personally observed a number of these operations and have witnessed in a number of patients a complete restoration of co-ordinated emotional facial function.

JAMES CRAIG JOYNER, M.D.

New York

# URETHRAL STRICTURE: ITS ANATOMICAL AND PATHOLOGICAL BACKGROUND

*To the Editor* As a result of recent publications apparently coming from my service at the Mt Sinai Hospital, New York City, the impression has gained ground that I have changed my attitude as frequently expressed concerning strictures of the ureter as described by Dr Guy Hunner of Baltimore.

The publication in the October number of *SURGERY, GYNECOLOGY AND OBSTETRICS* of the work done in Germany by Dr Martin Schreiber has no connection with the clinical study as carried out on my service at Mt Sinai Hospital. The fact that it was published with my name figuring rather prominently at the beginning of the article has given

numerous gentlemen who are interested in urology the impression that these studies incorporate my present viewpoint.

There is no need at the present moment for me to analyze this publication nor to point out the discrepancies between this work and that of Dr Guy Hunner.

In view of the fact that this paper was presented before the Academy of Medicine in New York at which time Dr Thomas J. Kirwin also contributed a paper and Dr Guy Hunner opened the discussion, it seems only proper to draw attention to my part of the discussion which took place that night and which was published in the *American Journal of Surgery* p. 59 July 1927. In this discussion I ended my remarks. I must conclude that I am as yet not convinced that he (Dr Guy Hunner) has proved his point that strictures are very common, that they are bilateral usually, that they are due to local infection, that they can be recognized regularly by the wax bulb hanging and that the ureter behind the stricture does not have to be dilated.

New York

EDWIN BEER, M.D.

# MEDICAL STUDY IN BERLIN

The American Medical Association of Berlin furnishes to American medical students, practitioners, and scientists any needed information concerning medical science courses, hospital and laboratory work in Berlin.

The officers of the association are in contact with all activities of the hospitals, clinics and the University of Berlin Medical School and they invite correspondence concerning the opportunities for medical study, cost of living, etc.

AMERICAN MEDICAL ASSOCIATION OF BERLIN

c/o Kaiserin Friedrich Haus

1. Luisenplatz - 4,

Berlin N.Wo.

# AMERICAN COLLEGE OF SURGEONS

## CELEBRATION OF LISTER CENTENARY

### PRESINTATION OF REPLICAS OF THE LISTER EXHIBITION

By HENRY S WELLCOME Esq LONDON ENGLAND

Honorary Fellow Royal Society of Medicine

**I**N HISTORIC calendar records the year 1927 will be memorable as the Centenary Anniversary of the birth of the immortal Lister

Lord Lister's indefatigable research work and epoch making discoveries in the field of surgical science have brought immeasurable benefits to mankind

From the beginning of time it has been the foremost aim of Good Samaritans to relieve pain and to postpone death. Toxic bacteria life's most deadly enemy infinitely minute invisible and irresistible held sway through the ages and ever defied the master minds of the healing art. In spite of great advances in surgical science deadly germs until recent times eluded detection and control

Pasteur's bacterial discoveries greatly influenced Lister in his memorable work which lead to his historic achievements in antiseptic surgery. Lister fully acknowledged his indebtedness to Pasteur

In London England April last a great International Centenary Lister Celebration was held. Delegates from all parts of the world attended. As the chief repository of Lister historical material the Historical Medical Museum was made the Official Exhibition of this Celebration

During his life and since his death this Museum has acquired many personal relics and an extensive collection of items used by Lord Lister and associated with his research work

Several years ago the scientific world was shocked by an announcement that the Royal Glasgow Infirmary where Lister had conducted his researches and made his historic discoveries was for economic reasons to be torn down. Regardless of world wide protests from leading scientists the local committee in control persisted in their purpose. House breakers were called in and demolition of the building begun. Then, through the aid of friends and associates of Lister we succeeded in securing an important section of the original Lister Ward in the Royal Glasgow Infirmary together with its original fittings furnishing and equip-

ment. These were transferred to London and now form the center of the Lister Collection in the Historical Medical Museum

Early this year several distinguished officials of the American College of Surgeons notified me of the intention to hold a Lister Centenary celebration in America, and requested me to aid them in their project

It gave us great pleasure to respond with an offer of the collection of replicas now on view in the American College of Surgeons Lister Centenary exhibition and intended to form a permanent exhibit in the Museum of the College. An exact model of the original Lister Ward is included in this collection

This collection is listed in the descriptive catalog supplied by the Historical Medical Museum. I desire to say that the members of my Museum staff carried out the preparation of this collection with the utmost zeal and enthusiasm having special regard to its destination and purpose

Special credit is due to Mr Malcolm conseruator of the Museum who directed and supervised the work

It seems to me most natural and appropriate that the American College of Surgeons should receive the co operation of the Historical Medical Museum of London. Both institutions were organized and born in the same year. Sir Rickman Godlee, nephew of Lord Lister and himself a very distinguished surgeon, was then president of the Royal College of Surgeons London. He was one of the Godfathers of the American College of Surgeons. Furthermore Sir Rickman gave interested co operation in the organization of the American College. Likewise Sir Rickman Godlee in the same year was one of the Godfathers of the Historical Medical Museum, London and gave interested cooperation in its organization

In the last section of the descriptive catalogue, is a brief excerpt from the speech of Sir Rickman when he assisted at the inauguration ceremony of the Museum



Section of the original Lister Ward from the Glasgow Royal Infirmary Wellcome Historical Medical Museum

Another link in the affiliation between the American College of Surgeons and the Historical Medical Museum is the Great Golden Mace inscribed "From the Consulting Surgeons of the British Armies to the American College of Surgeons in Memory of Mutual Work and Good Fellowship in the Great War, 1914-1918."

Mr. President, the original Great Golden Mace, rich in profoundly significant emblemism, rests on the pedestal before you. At the time of the presentation of this Mace to the American College of Surgeons, leading British Surgeons requested me to commission the sculptor of this remarkable example of Goldsmith's craft to execute an exact replica, to remain in England. That replica was wrought with fidelity and rests in the Hall of Statuary at the Historical Medical Museum, London.

While the American College of Surgeons holds the original Mace, as a sacred reminder, the Historical Medical Museum holds the replica as a reminder, equally sacred.

Of the Lister Collection, the American College of Surgeons now holds the replicas and the Historical Medical Museum holds the originals. Both collections will, I trust, serve as reminders of mutual good will, endeavor and co-operation in the promotion and advancement of the sciences of medicine and surgery.

I would like to mention one of my many personal obligations to America and American Surgeons. One of my most valued preceptors, and the one who, in my youth, inspired and guided me in my studies, and insisted on my qualifying myself for a career in the field of science, was that great pioneer surgeon in the West, Dr. William Worsley Mayo, the father of those two gifted surgeons, William and Charles Mayo, who have earned world-wide renown by their scientific achievements.

Mr. President, I beg you to accept this offering for the American College of Surgeons from the Historical Medical Museum of London.

THE president of the College, Dr. George David Stewart, accepted the replica of the Lister Exhibit in behalf of the officers and Fellows of the American College of Surgeons, and the following resolution of thanks was authorized by the Board of Regents:

WHEREAS the Wellcome Historical Medical Museum through the kindness and generosity of Mr. Henry S. Wellcome its Founder and Director has presented to the American College of Surgeons a replica of the Lister Collection in the Wellcome Museum in London and

WHEREAS Mr. Wellcome has so generously presented to the College for distribution copies of the descriptive catalogue of the Lister Exhibit and

WHEREAS this exhibit was the outstanding feature of the Lister Centenary celebration of the American College of Surgeons held in conjunction with its Clinical Congress at Detroit, October 3 to 7, 1927,

<sup>1</sup>For complete description of the Great Mace see Surg. Gynec. & Obst. 1920 222, 643-650.



THEFORE BE IT RESOLVED that the appreciation and thank of the officers Regents and Fellows of the American College of Surgeons be transmitted to the Wellcome Historical Medical Museum and to its founder and director Mr Henry S. Wellcome for this timely gift which is to have a place in the museum of the College where it will serve as a constant reminder to the Fellows and all visitors of the outstanding achievement of Lister the Founder of Scientific Surgery and the great debt which they owe to him for his epoch making discoveries and

BE IT FURTHER RESOLVED that the thanks and appreciation of the officers Regents and Fellows of the College be transmitted to the staff of the Wellcome Historical Medical Museum for their zealous and enthusiastic work in preparing the Lister collection and the descriptive catalogue and

BE IT FURTHER RESOLVED that the Director General of the American College of Surgeons be asked to transmit a copy of this resolution to Mr Wellcome and to the Wellcome Historical Medical Museum

## PRESENTATION OF THE LISTER MEMORIAL TABLET

PROFESSOR C. WETHERSIDE, M.D., MONTEREY, CALIFORNIA

THE Western Surgical Association was organized in 1895—thirty six years ago—and a few of the older members of that organization who are still living in the enjoyment of its fellowship and happy associations had been engaged in the practice of surgery for some years previous to that time. They were familiar with the conditions under which surgery had been done before Lord Lister's teachings had been accepted and generally adopted and in consequence they are today in a position to compare the then with the now and to appreciate what Lister's fundamental discoveries have meant to surgeons to surgery and to mankind.

No compilation of historical data, no traditions of the horrors of the surgery of the past can convey a true and impressive picture that will give succeeding generations an adequate understanding of the real significance and importance of the transition from the old surgical art to the new surgical science.

Lucas Championniere tells us that there are only two periods in surgery—that before Lister and that since Lister.

Most of the surgeons of the twentieth century accept modern surgery as taught and practiced today as a matter of fact. They take it as they find it without giving much time or thought to its antecedent history or the evolutionary growth that has made it what it is today. Many are therefore without a true realization of what they owe to Lister and to the development of modern scientific surgery founded upon the discoveries and teachings of Lister and Lister. They like the prodigal son of a too prosperous father for get that all they have and are or ever hope to become they owe, primarily, to him.

The Fellows of the Western Surgical Association particularly some of the old guard who

remember the days of putrid and sloughing stumps, septic ulcers, ligatures and suture and streams of laudable pus which can never be effaced from memory or totally wiped away from a retentive olfactory sense know and appreciate what Listerism has meant to mankind.

The epidemics of *pneumia crissipelas*, hospital gangrene, tetanus, sepsis and puerperal fever that once decimated the hospitals of the pre Listerian period are no more. Clean dry wounds and primary union are the rule rather than the exception and surgery has become the inviting field for the many instead of the unpromising and disheartening vocation of the few who dared its dangers and discouraging difficulties.

It is a rare privilege to have lived through this transitional period of modern medical and surgical development and some of us who have enjoyed that privilege are glad to have the opportunity to give expression to our gratitude to one who has made it possible.

As an evidence of the appreciation of the Fellows of the Western Surgical Association and as a slight token of the great obligations we all owe to Lord Lister this memorial tablet designed and modeled with exceptional artistry by Mrs. Julia Bracken Wendt was brought into being.

In casting about for a place in which our memorial should find a fitting environment it was decided by the executive council of the Western Surgical Association that the Murphy Memorial Building of the American College of Surgeons would be the most appropriate place in America to give it a proper setting.

It was therefore offered to the Regents of the American College of Surgeons and was accepted by them for the College with the understanding that it is to be given a place in the Murphy Memorial building.



Photograph of Lister memorial tablet (heroic size) presented by the Western Surgical Association to the American College of Surgeons at the celebration of the Lister centenary Detroit October 4 1927

As the Chairman of the Lister Memorial Committee of the Western Surgical Association I have therefore the honor to present in behalf of our Fellows to you Mr President as the representative of the American College of Surgeons this memorial tablet in commemoration of the epoch making discoveries of Joseph Lister The Founder of Scientific Surgery

This is our tribute to a benefactor of mankind It is given in the centenary year of his birth and we bestow it upon you with a reverent regard for the man and a deep appreciation of the work he did We entrust you with it in the hope and with the belief that it will find in your keeping an honorable and appropriate setting

Mr President—Doctor Lewis H McKinnie president of the Western Surgical Association will unveil our memorial to Lord Lister

In behalf of the officers and Fellows of the American College of Surgeons its president Dr George David Stewart accepted the Lister Memorial Tablet and the following resolution of thanks was authorized by the Board of Regents

WHEREAS the Fellows of the Western Surgical Association as a token of their great obligations to Lord Lister have made possible the execution of a tablet to his memory designed and modeled with exceptional artistry by Mrs Julia Bracken Wendt, and

WHEREAS the Association has selected the American College of Surgeons as the recipient of the Lister tablet, and the Murphy Memorial building of the College as the fitting environment and

WHEREAS this tablet was one of the outstanding features of the Lister Centenary celebration of the American College of Surgeons held in conjunction with the Clinical Congress of the College in Detroit October 3 to 5 19

THEREFORE BE IT RESOLVED that the thanks and appreciation of the officer Regents and Fellow of the College be transmitted to the Executive Council of the Western Surgical Association and to its Fellows for their kindness and generosity in preparing this beautiful and timely gift which will serve as a constant reminder to the Fellows of the College and visitors of the outstanding achievements of Lister the Founder of Scientific Surgery and the great debt which they owe to him for his epoch making discoveries and

BE IT FURTHER RESOLVED that a copy of this resolution be transmitted to the Fellows of the Western Surgical Association through its president Dr L H McKinnie who unveiled the Lister tablet and to Dr Horace Greeley Wetherill who in behalf of the Association presented the tablet to the American College of Surgeons in Detroit on the evening of Tuesday October 4 192

SOME PERSONAL RECOLLECTIONS OF LORD LISTER<sup>1</sup>

BY W. W. KILNARD, PHILADELPHIA

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PERSONAL recollections of such a great benefactor of the whole human race, who with Pasteur and Koch revolutionized modern surgery after twenty four centuries of groping progress, are always worth recalling. I make, therefore, no excuse for these few and slight contacts with this great yet modest surgical hero.

My first personal contact with Lister was at the International Congress of Medicine in Philadelphia, in September, 1876. It was not one of the regular triennial congresses, but met at the call of the medical profession of the United States in connection with our celebration of the Centennial of our National Independence. Europe participated with us to some extent. Especially should we remember with gratitude the wholehearted collaboration of Great Britain in the wonderful exhibition and the Medical Congress. How generous it was for the British, who had been defeated in the Revolutionary War, to help us, the victors, so liberally in celebrating our victory and their own defeat. The British delegation was by far the largest and the most distinguished. I need only name Lister, who was then president of the Royal Society, Inder Brunton, William Adams, the younger Simpson, Brudenell Carter, Argyll Robertson and Hingston of Montreal as examples.

Our surgical nestor, Samuel D. Gross, was elected president of the Congress and Dr. I. Minis Hays and myself were two of the general secretaries. Of course, Mr. Lister (as he then was), the successor of Syme in the chair of surgery in Edinburgh, was elected president of the surgical section. The chief event of the whole Congress was Lister's address and the following debate on antiseptic surgery.

His first paper on antiseptic surgery had been published when he was professor of surgery in Glasgow in 1867—nine years before our Congress. But on account of the cold reception of his new method by the British surgeons and the British medical journals, it had not attracted much attention in the United States.

No better illustration of the skeptical attitude of the English speaking profession could be cited than *Erichsen's Surgery* which was, from 1853, the classic surgical text book in English speaking countries for thirty years. Several editions

were reprinted in America and the work was translated into several foreign languages.

Lister's emphasis was always upon the septic germs in the atmosphere as the chief danger to be guarded against by means of a spray of a solution of carbolic acid. Not only one spray apparatus was recommended but two or even three, if so many were necessary to cover the whole field of operation. At first hand sprays were used, later steam spraying apparatus, as you have seen in the remarkable exhibit of the "Welcome Historical Medical Museum."

"One single septic germ in a wound," said Erichsen "would light up all the mischief." He overlooked the beneficent work of dear old Mother Nature.

Though he praised the antiseptic system calling it "as novel as it is scientific" yet in the two later editions of 1873 and 1878 he expressly declares "theoretically it is perfect, in practice its success is not constant."

In the edition of 1873 he even prints an illustration of the best method of introducing a seton into an abscess! I venture to say that not one of us has used a seton during the past 40 years.

I confess with shame now that I knew only the fact that Lister had introduced a new method of wound treatment by carbolic acid and that his system had been rejected by most British and American surgeons.

How primitive the conditions of travel as well as of surgery in 1876 were, is shown by the fact that Lister crossed in a then famous Cunarder the "Scythia" which had all sails set as well as her engine, yet she only made fourteen to fifteen knots for the wind had split her mainsail and delayed her arrival.

In his presidential address on antiseptic surgery to the Surgical Section, Lister spoke for 2½ hours and another hour was devoted to replying to questions.

The debate which followed his address was singularly one sided.

The "Spirit of St. Louis," however, then first burst forth, for that excellent St. Louis surgeon, John T. Hodgen, in opening the debate on antiseptic surgery advocated Lister's method. But he spoke chiefly of "germs," "catalytic germs," and "germinal matter," and contended that in tissues far removed from any possible contact

<sup>1</sup>Read before the Clinical Congress of the American College of Surgeons in Detroit October 4, 1927.

with germs putrefaction occurred. He advocated all means to exclude the germs. Frank Hamilton of New York and Kinloch of Charleston spoke in moderate commendation of Listerism. Others totally rejected the theory of the origin of putrefaction from germs and still others doubted the effect of the spray on intestines exposed to it in operations for hernia ovariectomy, etc.

The autocratic claim of Listerism as the only method was disputed and chlorine and perfect cleanliness and rest were asserted to be just as good. But we men of 1876 knew nothing beyond what I may call soap and water cleanliness and not Listerian cleanliness. We did not recognize till later that death lurked under our finger nails in our silk ligatures on our dressings on the skin of the patient, etc. Even in 1882 and 1883 in the American Surgical Association speakers manifested their disbelief in the bacterial origin of infection. Under the influence especially of Liebig oxygen had been deemed to be the cause of putrefaction. It required time, experimentation and the experience of repeated disasters following our old methods contrasted with the wonderful antiseptic successes to convince the surgical world of the value of Lister's principles.

I took no part in the debate for I knew far too little of antiseptics to warrant even a word. But the result was my firm conviction that Lister was right. I became in practice his first disciple in Philadelphia.

On October 1, 1876 when I went on duty at St. Mary's Hospital I found no means for practicing the antiseptic method. I collected the special dressings, an atomizer to fill the air with a carbolic atmosphere and the protective and other materials needed in the complicated ritual of that day. Later a wider knowledge abolished the spray especially when some of the surgeons and patients from prolonged inhalation of carbolic acid suffered from hæmaturia. From constantly washing them in carbolic solutions our hands soon looked ragged from the peeling epidermis like the old white birch bark of the forest.

Our progress was truly *per aspera ad astra* until today you know well how simple and how soul satisfying is our surgical technique.

I was Washington Allee's second assistant for some years and that foremost ovariectomist saved only one out of three of his patients and I heard my professor of obstetrics at the Jefferson declare that ovariectomists should be indicted for murder.

Repeatedly I have heard the elder Gross say to the orderly, 'Hughey, tomorrow I am going to lecture on suppuration—go to the hospital—a small affair of not over a dozen beds—tomor-

row morning and get me a half tumbler of pus. This was always on tap. What a contrast to today when you have to hunt for it and usually without success.

Secondary hæmorrhage was very common. In the Civil War out of 35 cases 1,433 61 per cent died as a result and many additional cases doubtless escaped being recorded. Ten days after the Battle of Gettysburg when I was on duty as officer of the day in the hospital I was called to five cases of secondary hæmorrhage in that single night. Never in all the thirty-one years of my later active surgical life did I see so many secondary hæmorrhages as on that one night. That tells the story! In the same war there were reported 318 cases of pyæmia of whom 747 97 4 per cent died. Does it not make your blood run cold to imagine such fearful results of pre-Listerian days?

Primary hæmorrhage was an occasion of boastfulness while today the luck of primary hæmorrhage is a reproach to any surgeon.

Such heart-breaking tragedies often made the surgeon wish he were a hod carrier or even in his grave.

I thank God such tragedies are now but specters of a horrid and vanished past.

How felicitous was Harvey Cushing in his notable address at the Lister Celebration in Edinburgh when he described Lincoln and Lister as the two greatest 'Emancipators!' The one freed millions from legal life-long slavery, the other emancipated all mankind from infection its most deadly surgical enemy.

How slow our progress was may be estimated from the following facts. From 1850 when Davaine merely noticed in the blood the little rods of anthrax as an observed but curious fact to 1888 when Koch first discovered the bacillus of tuberculosis had sufficient bacteria been discovered to allow of sorting them out and their orderly classification and therefore warranted the addition to the English language in 1884 of the word Bacteriology.

Look at our modern statistics as to ovariectomy compound fracture below the knee which Syme and most conservative surgeons formerly treated by amputation as the less dangerous alternative and recall our many other daring operations of today.

On the hard chest and abdomen *noli m tangere* was writ in large letters unless these cavities had already been opened by accident or disease.

*Per contra* some years ago I declared that the abdomen might now be called the playground of

the surgeon" so free were we in our license to open it, and operate successfully on any of its many important organs

The same might also be said of the head and the heart. We can now irrigate the lateral ventricles of the brain from side to side, and Cutler has lately shown us how to operate on the valves in side of the heart itself. All of this progress harks back to Lister's remarkable work, and to Pasteur, his fertile and wonderful predecessor.

We also believed, as taught by Florens, that the brain acted as a unit, like the liver or the kidneys, until Fritsch, Hitzig, Ferrier, Horsley, and others showed us that in the brain various regions were strictly localized, with many special centers for motion, vision, audition, etc. The earliest "localization of function" in the brain was Broca's center for speech, located by clinical and postmortem evidence, in the third left frontal convolution of the brain. This is the only "center" which has not been discovered by experimentation upon animals, and verified by many operations on man. So accurate is this localization that in one case the removal of a cube of grey matter one quarter of an inch in size paralyzed all the nine muscles moving the thumb, and not another muscle.

We can open knee joints, do what we wish, and close them again without any assured following infection requiring a frequently fatal amputation.

Amputations of the breast now heal within a short time instead of weeks and months. We laugh at the worry and the sleepless nights of Sir Astley Cooper, as related in his *Life* by his nephew Bransby Cooper, before he removed a simple wen from the head of the King, lest erysipelas and death should follow. Yet that was an ever prevalent danger, especially about the head, before Lister's day.

All aseptic wounds are healed quickly and without what had been formerly, and appropriately, called "surgical fever," for, in the earlier days, all operations were followed by fever as an expected and a constant result, and not seldom also by death.

Dr J. Ewing Mears followed me in St. Mary's Hospital, January 1, 1877, and he and every one else on the staff continued the antiseptic treatment initiated in St. Mary's Hospital on October 1, 1876.

My second personal contact with Lister was in 1907. I knew that his 80th birthday would occur on April 5. I reached Berlin on April 1 and stayed in the Hotel Continental. The annual meetings of the German Surgical Society are always held in the Spring and as I had just resigned

at the Jefferson in January, on my 70th birthday, it was my first opportunity to attend the Congress of which I had been elected an Honorary Fellow while in India in 1902.

I wrote to Lister from the hotel a letter of congratulation, adding that I well knew that I was but voicing the unanimous American appreciation of his wonderful contributions, not only to surgery, but to the welfare of the whole human race in nearly every department of medicine, and also to animals.

On his birthday I received a brief holograph letter of thanks for my letter.

About a month later, fearing that I was a temporary traveler at that hotel and might easily have passed on and never have received his reply, I received a second four page holograph letter sent to my Philadelphia address thanking me for my kind congratulations. Godlee's *Life* records that on his birthday he was "overwhelmed with letters and telegrams from all over the world," yet this courteous gentleman, as he ever was, took time to send this second and longer holograph letter lest his first one should have failed to reach me. What a pattern for our whole profession.

My third contact was again through a famous letter.

In 1900 in Washington we had a "Field Day" over vivisection. Senator Gallinger of New Hampshire, had an M.D. degree and had practiced for a time, but then abandoned medicine for politics. He had introduced a bill prohibiting experiments on animals in the District of Columbia and all the national territory in the Philippines, Porto Rico, etc., which if passed, would be a long and powerful lever for a similar prohibition with all state legislatures. Each side marshaled its forces for a pitched battle. Our leader was Dr. William H. Welch of Johns Hopkins. Bishop Wm. Lawrence of Massachusetts came from Boston and helped mightily. On April 4, 1908 Lister in response to my request had sent me a 3½ page foolscap holograph letter setting forth his experience and opinions as to experiments on animals. At my request Dr. William H. Welch put this letter in evidence before the Committee and it was published in full in their report. It had great weight with them.

The original letter I have given to the College of Physicians. It has been placed in the vault. A photostat copy between double glass plates swings in a frame in our library, with a note telling its history.

The bill was killed. A year or two ago a similar one was easily killed chiefly by the influence of the local profession in Washington.

An appreciation of Lister's marvellous work has been a part and I may truly say the most influential part of the forces of scientific surgery which brought about its victory—now practically continuous with the surgical world—the greatest revolution in surgery since the days of Hippocrates 4 centuries ago. Many others especially in England, Germany and France (not forgetting the able part played especially by Kocher in Berne) soon followed. After 1876 the battle was soon won with the vast majority of English speaking surgeons. Today only a few older and ill informed surgeons are still unconvinced.

Instead also of chemical antiseptics we learned that prolonged exposure to heat and wide disinfection of the skin of the patient by iodine and surrounding the field of operation by disinfected sheets and towels created an *aseptic area* in which it was safe for disinfected hands and instruments to be freely used in the saving of human life and the abatement of human suffering.

When the Great War began we continued this aseptic treatment but it was soon found that the

forces of infection were so extensive and so virulent that our mild asepsis could not cope with them.

Hence the Carrel Dakin and other methods of continuous disinfection replaced our old methods with most satisfactory results.

But all these methods are lineal descendants of Joseph Lister.

Let me urge upon every young and aspiring surgeon to 'read mark learn and especially to digest inwardly' the *Collected Papers of Lister* if he wishes to know that great man and what he accomplished.

In 1902 the Royal Society gave a banquet in honor of the 50th Anniversary of Lister's doctorate. That occasion was made memorable especially by the peroration of the American Ambassador Mr. Bayard's address in one of his happiest after dinner speeches. Turning toward Lister who in 1883 had been elevated to the peerage he said 'My Lord it is not a Profession, it is not a Nation it is Humanity which with uncovered head salutes you.'

## THE FOURTH EPOCH OF MEDICINE<sup>1</sup>

By WILLIAM J. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

**M**EN in every age in times of spiritual or material stress have risen to saving intellectual heights far above the level of their environment. Such a man was Abelard the dialectic philosopher of the twelfth century who perhaps has been best known through the great human tragedy of Abelard and Heloise.

The dark ages which were precipitated by the downfall of the Western Roman Empire began to lighten in the twelfth century as manifested by an emotional awakening for which the crusades were largely responsible. The crusaders on their return from the East brought with them the knowledge of the ancient philosophers which fortunately although submerged had not been completely lost. Abelard, Lombard and other men of the time were leaders of this resurrection of thought and staunchly proclaimed the dictum that understanding is essential to belief in contradistinction to the controlling ecclesiastic concept that belief is essential to understanding. Their teachings were those of Aristotle, modified to apply to Latin conditions.

From the intellectual controversies of the times sprang the University of Paris under William of

Champeaux founded in the first decade of the twelfth century to be followed by Oxford University in 1210 and Cambridge University in 1231 the first evidences of systematic education in medieval times.

### THE FIRST EPOCH OF MEDICINE

Aristotle was physician to Alexander the Great. When Alexander died at the early age of 33 years after conquering almost the known world his empire was divided and Egypt and the Near East were governed by the general Ptolemy who established in the capital city named for Alexander on the delta of the Nile, a great museum and library, a treasure house of ancient culture. From Alexandria the Ptolemies ruled Egypt for three hundred years. Cleopatra immortalized by Shakespeare was the last of that ill fated line. The greatest contribution in the first epoch of medicine was made by the students of Aristotle in Alexandria who developed scientific methods of investigation.

Hippocrates a near contemporary was the first to apply Aristotle's methods of reasoning to the treatment of disease, and he it was who

<sup>1</sup> Lister address delivered at the Clin. Cong. of the American College of Surgeons October 4, 1917, Detroit, L.

inaugurated the struggle against medical superstition which continues to this day. The aphorisms of Hippocrates are known to every medical student, the Hippocratic oath is a condition of fellowship in the American College of Surgeons. Is it any wonder that rational methods of investigation as laid down by the Aristotelian school in the Ptolemaic era should have controlled scientific thought in medicine for two thousand years?

That great breach in the church which occurred in the fourteenth century was perhaps most marked in England. The medieval period brought a spiritual and emotional change to the people, led by a militant church, evidences of which remain in the ruins of magnificent old abbeys and castles. The division brought about by the leaders of the Reformation led to the great schism which enabled Henry VIII, of unsavory memory, to establish the Church of England with himself as head. To Henry VIII belongs at least the credit of establishing at Oxford University in 1546 the first medical school in England.

#### THE SECOND EPOCH OF MEDICINE

The reign of Elizabeth, daughter of Henry VIII, may be called the most illustrious of all periods of the world's history. The great mental and moral disturbances of the times led to a spirit of investigation which freed the intellect from dogma. In the realm of discovery and conquest a brilliant figure was the buccancer, Sir Francis Drake, who was the second to circumnavigate the known world, and whose nautical skill defeated the Spanish Armada. Literature in this period was enriched by Shakespeare's gift of his great dramas, which have never been equalled.

Science, which had depended for twenty centuries on the primitive methods of the deductive logic of Aristotle, received a new impetus through the development of the inductive logic of Francis Bacon, and scientific imagination developed, resulting in the building of images to be compared with known facts. This new logic added greatly to scientific resources, it enabled William Harvey, who had studied anatomy at Padua under Vesalius, Fabricius, and Casserius, to demonstrate the circulation of the blood. We think of Harvey only as the discoverer of the circulation of the blood, but his work reached far beyond the elucidation of isolated facts. Harvey was an anatomist as well as a physiologist. He recognized that one purpose of the pericardium was to protect the heart from bursting during violent physical strain, he recognized that the peculiar twisting motion of the heart was to

enable its cavities to empty themselves of the blood they contained, as a wet cloth is freed from water by wringing. All of the scientific undertakings of Harvey were characterized by the same logical association of facts that he manifested in his observation of the circulatory system. He was the founder of organized experimentation and research in medicine, and when necessary used vivisectional methods in controlled experimentation to parallel clinical experience.

Sydenham, of precious memory, was the clinician of Harvey's time, and what Hippocrates was to Aristotle, Sydenham was to Harvey. Sydenham, with a clear mind and a hatred for sham and hypocrisy in medicine, gave us the finest insight of all time into clinical medicine as related to current knowledge. While we look on him as the proponent of sound theories of the causation and classification of fevers, this investigation was merely one expression, and that almost incidental, of his clinical acumen, which led to many advances in medical science.

The second epoch of medicine produced another man about whom we have heard little, John Mayow, one of the first of the physician chemists. The observations and experiments of Mayow led to the discovery of oxygen, and now, after nearly three hundred years, we are just beginning to understand those fundamental problems which connect physicochemistry with the medical sciences. The impetus given by the work of Harvey, Sydenham, and Mayow led to rapid advances in knowledge of the sciences in relation to clinical medicine.

During this fertile age came the first crude form of the microscope, introduced by the Janssen brothers in 1590, the most significant scientific contribution of all time, which was destined to revolutionize medicine and to change the history of mankind. This discovery came too late to benefit Harvey greatly, but it gave the hand lens to Hunter and the modern microscope to Pasteur and Lister.

#### THE THIRD EPOCH OF MEDICINE

Two brothers, William and John Hunter, coordinated knowledge in anatomy, physiology, and pathology so that for the first time these basic sciences became a coherent whole. They put medicine on a sound foundation. The Hunters' greatest single contribution was the discovery of the lymphatic system, as related to the organs and tissues of the body, which in many respects was as far reaching as the discovery of the circulation of the blood, and opened up a vast field of research which is still under way.



William Hunter analyzed the normal functions of life with remarkable understanding and correlated them by the inductive method. He made many contributions to science the importance of which as newer discoveries have proved the acumen of his outlook has only recently been recognized. Conspicuous among these contributions was the demonstration of the contagious nature of childbed fever.

John Hunter had the divine discontent which leads to progress. He was the first to study pathology as a whole and it was he who related general pathology to clinical medicine. Previous to Hunter's time great truths were discovered in pathology and medicine but they were largely isolated and uncorrelated. He originated the Hunterian Museum of the Royal College of Surgeons in London and prepared 16,000 specimens with his own hands an illustration of a sound conception of medicine one hundred years in advance of his time.

The Hunters in their dissections had owing to the Janssens the incomparable advantage of a crude form of microscope and the hand magnifying glass which enabled them to follow the course of injections of dyes into vascular and lymph channels. Belchier of Guy's Hospital in 1764 had introduced madder dye for this purpose.

Contemporary with the Hunters and the outstanding figure of the epoch was Edward Jenner a country physician who discovered that inoculation with cowpox prevented the development of the dread scourge of the time smallpox. John Hunter who was interested in animal experimentation writing Jenner in friendly exasperation after attending a meeting at which Jenner had propounded his theory of vaccination for smallpox without proof said: "Why submit hypotheses? Try it on a hedgehog and know." From this modest beginning developed the whole fabric of immunization antitoxin antitetanus antivenom and all the other lifesaving agents of this character now in existence.

Inspired by the work of the Hunters and of Jenner the spirit of inquiry spread. England became even more firmly established as the center of the medical sciences. Experimentation stimulated vision and from experimentation came splendid contributions to clinical medicine. From Guy's Hospital alone came the researches of Bright, Addison, Hodgkin and Pagge to mention only a few.

In the realm of pure science Brown the English botanist first used reflection of light to detect ultramicroscopic objects the motion of which

in the air and in solutions was known as Brownian movements. Dalton promulgated the atomic theory and described the dance of the molecules. Graham master of the mint in London elucidated Dalton's and Brown's discoveries in the field of colloidal chemistry and Darwin propounded the theory of evolution which through its opponents as well as its proponents has stimulated researches in the animal kingdom the importance of which as Keith points out cannot be overestimated.

In the middle period of medical advancement the microscope had been greatly improved in France and because of this France became a rival of England in medical science and in the development of scientific medicine.

It is interesting to note that Langenbeck the father of German surgery was a student in France and carried back to Germany the beginnings of learning which led to the pre-eminence of Germany in the medical sciences.

#### THE FOURTH EPOCH OF MEDICINE

In the light of the foregoing sources of scientific stimulation was inaugurated the fourth epoch of medicine in which two great names are inseparably united in work that stamped out the plagues of infection and communicable diseases. With the advantage of improved microscopes and the development of staining and cultural methods Pasteur developed his theory of the origin of diseases in microorganisms and changed the whole aspect of medicine. He applied his knowledge to the salvation of horticulture in the vineyards of France and to animal husbandry in the immunization of domestic animals to the dread anthrax.

Lister had been making extraordinary discoveries with regard to the suppuration of wounds and its prevention before Pasteur's work gave the clue to the cause. Lister applying Pasteur's discovery to the origin of contagious disease established the relationship of microorganisms to infections and putrefactive processes and formulated methods of prevention which were to be the greatest gift made by man to surgery.

On account of the discoveries of Pasteur and Lister hospitals for the first time became safe. Previously suppuration and gangrene had caused such a ghastly mortality that patients were actually safer if operated on in the wilderness than in the hospital.

Lister was one of those rare men who was gifted with both originality and practicality. That unusual combination of the investigator and the clinical surgeon he sought his discoveries in

relation to human need and applied them in a scientific manner

The culminating contribution of the fourth epoch of medicine has been the wider application of the work of Pasteur and Lister. The diseases that enter the body from without, namely, those caused by micro organisms have largely been discovered and classified, and means of destruction of the micro organisms themselves, or immunization to them, have been discovered or are on the way to discovery.

Dr. Keen, in his inimitable address tonight has given us glimpses of Lister the man. I speak rather of the inspirations that have been derived from Lister's work. His undertakings were heroic in conception. They caught the imagination of man and centered on medicine the sympathetic interest of the people of every country.

The medical profession has been reproached for its slowness in accepting scientific discoveries. The physician deals with human life and not with the replaceable elements of industry.

Men in medicine in spite of limitations are eagerly studying advances in science which mean so much to the future of the race. The whole fabric of the great advances in biological science

in the last generation was woven with microscopy, but the limit of microscopic research has been nearly reached.

The mind of man was built up coincidentally with the eye and it is this fact and not the mechanics of the eye, that has made intellectual progress possible. Man only has achieved satisfactory results with the visual brain. In the other primates, the apes, monkeys, marmosets, and lemurs, it has dulled the olfactory sense which controls the behavior of the lower vertebrates without a satisfactory substitute in the visual sense.

Just as the unaided eye opened the great field of the first and second epochs of medicine, and the microscope in the third and fourth epochs increased the acuity of vision so have ultramicroscopic methods by tremendously extending vision either directly or by means of mensuration, made possible new and wonderful scientific advances.

The fourth epoch of medicine faces the fifth which lies just ahead. In the fifth epoch achievement concerns the individual and those changes in the tissues which we speak of as metabolic, which lie in the ultramicroscopic field of the colloids, where life itself resides.

## AN APPRECIATION OF LORD LISTER<sup>1</sup>

By Sir JOHN BLAND SUTTON, Bt, LL.D., M.D., F.R.C.S., LONDON, ENGLAND

**S**URGERY should interest every living person. Everyone born into this world alive is the subject of an operation—the simplest operation known to surgeons—omphalotomy, which consists in tying and cutting through the navel string. This simple operation requires a thread and something with which to divide the cord—scissors, knife, potsherd, a sharp piece of flint or, as in the way of animals, it may be bitten through. Prehistoric midwives probably used for a ligature fiber from plants, bast, tendons from animals, or the legs of birds, or catgut. In pre-Listerian times this simple operation had a dreadful mortality from sepsis, the umbilical vein serving as the channel of infection. Sepsis due to dirty threads and fingers was further encouraged by the time honored practice of applying cow dung poultices to promote the separation of the stump. Today, strict measures for avoiding sepsis prevail in the birth room and there are as many fanciful methods of amputating the placenta, as in excising a pile!

Nothing gave Lister more anxiety in the conquest of surgical sepsis than ligatures

The most remarkable extension of surgery which ensued on the appreciation of Listerian principles may be covered by the phrase—the surgery of serous cavities—the peritoneal cavity, the meningeal cavities—cranial and spinal, and the serous cavities called joints. Lister did attack joints successfully under carbolic acid precautions. He attempted to invade the abdominal cavity, but failed. Lister's surgical experience had not equipped him to invade the abdomen. Serous cavities will not tolerate strong antiseptic solutions. In my early experience I abandoned carbolic acid in abdominal operations. Lister's principles I followed, but not his methods. Take for example the ancient operation of cesarean section. In the hands of surgeons up to 1860 this operation was more fatal than the "rough and ready" amputations of the lower limb, but it has been performed successfully by a butcher, by a patient on herself, and by the horn of a mad bull. In each of these three instances the child survived as well as the mother.

Today the cesarean operation is brilliantly successful when associated with aseptic pre-

<sup>1</sup> Presented at the Clinical Congress of the American College of Surgeons, Detroit, October 4, 1917.

cautions. Signal success in operations on the abdominal organs is not restricted to the few, but is the reward of any careful surgeon trained in modern methods, possessing anatomical knowledge and surgical aptitude.

The extension of intradural surgery has been attended with astounding success as well as an extraordinary increase in an accurate knowledge of the pathology of the central nervous system.

Today able men are conquering the surgery of the thorax and the vital organs contained in the mediastinum and are supplying that knowledge which Murphy in the preface to the first volume of his *Clinics* in 1912 called *long* pathology! I have already said that Lister was shy of the abdomen but in the extraordinary progress of surgery he was the pioneer. We do not slavishly follow his ritual but we heartily accept his principles. Toward the end of his life he became a lonely old man and was obsessed with the idea

that the younger surgeons were trying to deprive him of credit for antiseptic surgery and give it to aseptic surgery!

Few pioneers in surgery have had the great privilege which Lister enjoyed of seeing his work appreciated throughout the world.

In the last 15 years of his life I often saw him taking exercise on a summer evening in Park Crescent where he lived and near where his monument stands in Portland Place. In my wildest fancy I never thought that it would fall to my lot to unveil the Lister monument.

March 13, 1924 was a cold dark day, a bitter northeast wind blew and as I ended a short speech saying 'Lister's influence will remain as long as surgery is practiced as an Art and his principles will continue as a blessing on every race of mankind' I pulled the cord—suddenly a glorious flash of sunlight broke through a rift in the clouds and shone on the monument.

